Policy Support for Innovative Entrepreneurship – An Empirical Evaluation

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German Summary / Deutsche Zusammenfassung

Entrepreneurship wird als entscheidender Mechanismus ökonomischer Entwicklung betrachtet – als treibende Kraft hinter Beschäftigung, Wettbewerbsfähigkeit und Wachstum in einer globalisierten Wirtschaft. Der ökonomische und gesellschaftliche Stellenwert von Entrepreneurship spiegelt sich seit den 1990er Jahren in Schlagworten wie der „entrepreneurial economy“ wider (Audretsch and Thurik, 2001). Audretsch (2003) argumentiert, dass sich im Zuge der Globalisierung Hochlohnländer auf wissensbasierte innovative Aktivitäten konzentrieren müssen, wenn sie gleichzeitig hohe Löhne und hohe Beschäftigung sicherstellen wollen. Wissen kann im Gegensatz zu anderen Produktionsfaktoren nämlich gerade nicht ohne Weiteres global verlagert werden: Die regional- und innovationsökonomische Literatur hat gezeigt, dass die Aneignung von Wissen absorptive Fähigkeiten voraussetzt und auf ein relativ kleines Gebiet um die Wissensquelle (wie Universitäten oder Forschungseinrichtungen) beschränkt ist. Der Politikfokus sollte daher in der Generierung und dem Transfer von Wissen liegen. Das umfasst auch, den Einzelnen zu unterstützen, unternehmerische Möglichkeiten wahrzunehmen und umzusetzen. Unternehmensgründungen stellen dann einen wichtigen Mechanismus der Kommerzialisierung von Wissen dar – und bilden damit die Verbindung zwischen lokalen Investitionen in Bildung, Forschung und Entwicklung einerseits und regionalem Wirtschaftswachstum andererseits.

Viele verschiedene Politikmaßnahmen – von der Einwanderungspolitik bis zur Steuergesetzgebung – wirken auf das Gründungsgeschehen. Als „Entrepreneurship Policies“ werden jedoch nach Hart (2003a) diejenigen politischen Initiativen verstanden, die mittelfristig Gründungsaktivitäten beeinflussen. Die vorliegende Arbeit folgt Lundström und Stevenson (2005, S. 45ff.) in ihrer Definition von Gründungsförderung: Die Gründungsförderung umfasst demnach Maßnahmen, die die Motivation und Fähigkeiten der (potenziellen) Gründer sowie deren unternehmerische Möglichkeiten zu beeinflussen suchen. Sie wendet sich so an (potenzielle) Gründer in der Vorgründungs-, Gründungs- und Nachgründungsphase. Ziel der Maßnahmen ist es, mehr Menschen zu einer unternehmerischen Karriere zu ermutigen und aus ihnen erfolgreiche Unternehmer zu machen. Im Freistaat Thüringen existieren verschiedenste Fördermaßnahmen, die der Gründungsförderung zugerechnet werden können, oft aber z.B. der Innovationspolitik, der Arbeitsmarktpolitik oder der Mittelstandspolitik entstammen. Diese Arbeit untersucht finanzielle Fördermaßnahmen wie Zuschüsse, geförderte Darlehen und Bürgschaften

(Kapitel 2), öffentlich geförderte Beratung für werdende Gründer (Kapitel 3) sowie Subventionen für die Forschung und Entwicklung junger Unternehmen (Kapitel 4 und 5).

Die vorliegende Arbeit entstand im Rahmen der „Thüringer Gründer Studie“, eines interdisziplinären Forschungsprojekts an der Friedrich-Schiller-Universität und der Fachhochschule Jena, das mit dem Projekttitel „Erfolg und Misserfolg innovativer Unternehmensgründungen – Eine prozessorientierte Analyse ökonomischer und psychologischer Faktoren“ im September 2006 startete. Von Januar bis Oktober 2008 führte das Projektteam nahezu 800 persönliche Interviews mit Thüringer Gründern durch, wobei auch werdende Gründer und Gründer, die ihr Unternehmen aufgegeben hatten, befragt wurden. Die Interviews umfassten zum einen Fragen zur Person des Gründers, z.B. zu unternehmerischen Interessen in der Jugend, zur Ausbildung und Berufserfahrung und zur Motivation der Gründung. Zum anderen wurden unternehmensbezogene Daten erhoben, etwa zu beanspruchten Fördermaßnahmen, zur Mitarbeiterentwicklung und zur Finanzierung der Gründung. Diese Daten bilden die Grundlage für die empirischen Analysen dieser Arbeit. Je nach Fragestellung konzentrieren sich die folgenden Teile der Arbeit auf verschiedene Untergruppen der durch eine Zufallsstichprobe ausgewählten Gründer. Die jeweilige Datenbasis wird dann in den entsprechenden Kapiteln beschrieben.

Nach einer Einführung werden in Kapitel 2 allgemeine finanzielle Subventionen untersucht, die mit Fällen von Marktversagen begründet werden. Auf Basis der theoretischen Erklärung und der empirischen Evidenz für Marktversagenstatbestände werden Charakteristika von Gründern und ihren Gründungen herausgestellt, die am ehesten von Kreditmarktversagen betroffen sind und / oder von denen positive externe Effekte ausgehen. Darüber hinaus wird in diesem Kapitel untersucht, ob die Allokation der Fördermittel diese Fälle von Marktversagen adressiert. Die empirische Analyse deutet darauf hin, dass sich die Förderung nicht auf Unternehmen konzentriert, die wahrscheinlich von Marktversagen betroffen sind. Die mangelnde Zielgenauigkeit der Fördermittelvergabe kann mit den Schwierigkeiten, ex-ante Kapitalmarktversagen und positive externe Effekte zu identifizieren sowie Public-Choice-Überlegungen erklärt werden. Auch können sozialpolitische Gründe die Fördermittelgabe bestimmen (z.B. Gründungsförderung als arbeitsmarktpolitisches Instrument). In Kapitel 2 wird argumentiert, dass die nicht zielgenaue Förderung in Ineffizienz resultiert, da so junge Unternehmen, die nicht von Marktversagen betroffen sind, unnötig Fördermittel bekommen. Mit einem Matching-Verfahren wird zu jedem geförderten ein ähnlich aufgebautes, nicht gefördertes Unternehmen gesucht. Die Performance-Unterschiede dieser Zwillingsunternehmen, die sich nur im Erhalt von Fördermitteln unterscheiden, können dann als Effekt der Förderung

interpretiert werden. Das Matching-Verfahren kann keinen Effekt der Fördermittel (in Form allgemeiner Zuschüsse, geförderter Darlehen oder staatlicher Bürgschaften) auf Beschäftigungswachstum oder Bonitätsindex bei den geförderten Unternehmen zeigen – eine Indikation für ineffiziente Subventionierung. Fehlende Beschäftigungseffekte oder Verbesserungen des Bonitätsindexes implizieren aber keine völlige Wirkungslosigkeit der Förderung. Vielmehr sind von wenig zielgenauer Förderung Marktverzerrungen zu erwarten: Subventionen verschaffen geförderten Unternehmen einen künstlichen Wettbewerbsvorteil. So besteht die Gefahr, dass geförderte Unternehmen effizientere – aber nicht geförderte – Unternehmen aus dem Markt drängen.

Das Kapitel 3 evaluiert öffentlich geförderte Beratung von Gründern im Gründungsprozess und basiert auf einem gemeinsamen Arbeitspapier mit Dipl.-Psych. Martin Obschonka. Angesichts der Vielzahl von einzelnen Beratungsangeboten für werdende Gründer und der ausgeprägten Selbstselektion in Beratungsmaßnahmen, untersucht Kapitel 3 in einem ersten Schritt die tatsächliche Inanspruchnahme in Bezug auf Inhalte und Intensität der Beratung. Eine Clusteranalyse zeigt, dass Gründer entweder intensive Beratung zu operationalen und strategischen Fragen in Anspruch nehmen, oder sich ihre Inanspruchnahme auf einmalige Beratung in operationalen Fragen beschränkt. Regressionsrechnungen deuten zweitens darauf hin, dass werdende Gründer mit mangelnden unternehmerischen Voraussetzungen intensivere und umfassendere Beratungsleistungen in Anspruch nehmen und diese auch als nützlicher empfinden. Mangelnde unternehmerische Voraussetzungen zeigen sich in geringem unternehmerspezifischem Humankapital (z.B. Mangel an unternehmerischen Vorerfahrungen oder Rollenvorbildern), mangelndem Sozialkapital (z.B. Fehlen von Gründungsunterstützung aus dem Bekanntenkreis) sowie einer wenig ausgeprägten unternehmerischen Persönlichkeitsstruktur. Das subjektive Nützlichkeitsempfinden der Gründer zeigt potenzielle Wirkungsmechanismen der Beratung auf, da sich Beratungsangebote an die Person des Gründers richten (im Gegensatz zu finanziellen Förderinstrumenten, die dem neu gegründeten Unternehmen selber zukommen). Öffentlich finanzierte Beratungsangebote werden meist mit positiven externen Effekten gerechtfertigt, die von innovativen Unternehmen gut ausgebildeter (beratener) Gründer ausgehen. Der Vergleich von Unternehmen mit Beratung im Gründungsprozess zu gleichartigen Unternehmen ohne Beratung im Gründungsprozess (Matching-Ansatz) kann jedoch keinen Effekt der Beratung auf den späteren Unternehmenserfolg (gemessen anhand der Höhe des Startkapitals zu Beginn des ersten Geschäftsjahres sowie Beschäftigung und Bonitätsindex im dritten Geschäftsjahr) feststellen.

Grundlage für Kapitel 4 und Kapitel 5 bilden zwei Arbeitspapiere zu Fördermaßnahmen für Forschung und Entwicklung (FuE) in neu gegründeten Unternehmen, die zusammen mit Prof. Dr. Uwe Cantner entstanden. In Kapitel 4 wird die Allokation von FuE-Subventionen untersucht und argumentiert, dass Politiker und Programmverantwortliche eine Strategie des „picking the winner“ verfolgen. Angesichts der Informationsprobleme, im Vorhinein Fälle von Marktversagen zu identifizieren, werden Förderentscheidungen zugunsten der ex-ante am Erfolg versprechendsten Gründungen gefällt. Dadurch werden Marktverzerrungen durch die Subventionierung nicht-effizienter Gründungen vermieden. Auch minimiert sich für Politiker und Programmverantwortliche das Risiko, später die Förderung gescheiterter Projekte vertreten zu müssen. Logistische Regressionen unterstützen diese Argumentation nur teilweise. Einerseits erhalten diejenigen Unternehmensgründungen mit den innovativeren Geschäftsideen – besonders akademische Ausgründungen – eher Fördermittel. Andererseits haben die Motivation und die Patenterfahrung der Gründer keinen Einfluss auf die Wahrscheinlichkeit einer Förderung, obgleich auch diese Charakteristika als Prädiktoren für späteren Unternehmenserfolg gewertet werden können.

Kapitel 5 untersucht die Effektivität von FuE-Subventionen anhand ihrer Wirkung auf Patentierungsaktivität und Beschäftigungswachstum. Matching-Verfahren berücksichtigen die Selektionsverzerrung zwischen subventionierten und nicht-subventionierten Unternehmen und zeigen, dass die Subventionierung von FuE bei neu gegründeten Unternehmen zu einem gleichzeitigen Anstieg des Beschäftigungswachstums von 66 Prozent führt. Des Weiteren weisen subventionierte Start-ups eine um 2,8-fach höhere Patentierungsaktivität auf. Diese Schätzungen deuten kaum auf die viel zitierten Mitnahmeeffekte hin. Bei der Analyse sticht die Gruppe der akademischen Ausgründungen durch ihre Innovativität und Patentierungsaktivität hervor. Für manche dieser High-tech Start-ups können keine nicht-subventionierten Zwillingsunternehmen gefunden werden, was einem erfolgreichen Politikfokus der letzten Jahre auf akademische Ausgründungen zugeschrieben werden kann.

Angesichts der Vielzahl von sich stetig ändernden Programmen und Fördermittelinstitutionen basieren alle Untersuchungen auf Angaben der befragten Gründer zur Inanspruchnahme einzelner Fördermittelarten in den einzelnen Phasen des Gründungs- und Unternehmensprozesses. So wurden keine Daten zur Inanspruchnahme einzelner Programme bestimmter Fördermittelgeber erhoben. Dieses Vorgehen schränkt die Fähigkeit konkreter Politikempfehlungen ein, weist aber auf ein Problem der Gründungsförderung hin: die sehr kleinteilige Programmlandschaft mit verschiedensten

Förderinstitutionen und stetige Änderungen in den Programmen verkleinern Fallzahlen und erschweren damit quantitative Evaluationen. Gleichzeitig sollte zukünftig schon bei der Konzeption und Implementierung von Förderprogrammen die spätere Evaluation durch (quasi-)experimentelle Designs berücksichtigt werden.

1. Introduction

1.1 Purpose and relevance

Schumpeter, in his seminal work in 1911, recognized entrepreneurial initiative as an important microdeterminant of economic growth, a concept that has become increasingly influential. Today, entrepreneurship is considered a crucial mechanism of economic change. Entrepreneurs introduce innovation and by doing so challenge and displace less innovative incumbents, a process Schumpeter dubbed "creative destruction". In this way, innovative entry accelerates structural change. Furthermore, products and services offered by new firms offer greater variety to consumers and have the potential to better match consumer preferences (Fritsch, 2008). These effects are not necessarily limited to the region or the industry of entrepreneurial start-up activity. Indeed, much research investigates the effect of entrepreneurship on employment, competitiveness and structural change, and finally, on economic growth in a globalized economy (see, e.g., Audretsch et al, 2006; Carree and Thurik, 2003).

The impact of entrepreneurial activity on economic performance differs across countries (Wennekers et al., 2005; Thurik et al., 2008) and becomes apparent only in the long run: the time lag between start-up activity and subsequent economic performance can be as long as 10 years (Fritsch and Mueller, 2004; Thurik et al., 2008; van Stel and Suddle, 2007). Moreover, Koellinger and Thurik (2009) show that entrepreneurship not only stimulates long-run economic growth, but also plays an active role in the business cycle. Employing data from 22 OECD countries between 1972–2007, they find that entrepreneurship is a leading indicator of the business cycle and Granger-causes increases of GDP. This suggests that entrepreneurship is also an important mechanism in recovering from economic recessions.

The entrepreneurs' role in an economy has not only been considered by Schumpeter but dates back to the work of Richard Cantillon (1755) as well as Jean-Baptist Say (1803), and has been of interest to economists ever since (van Praag, 1999).[1] However, it was not until the 1990s that the impact of entrepreneurial initiative gained the attention of society at large and became the focus of policy. In the 1950s and 1960s, both Western Europe and North America were characterized by a high concentration of economic activity in conglomerates in order to exploit economies of scale, a period known as the "era of mass production" (Audretsch, 2003, p. 22). In the mid-1970s, however, a shift in the industrial structure away from large corporations and toward small enterprises started to become

[1] For an overview of classic views on entrepreneurship, see van Praag (1999) and Hébert and Link (1988).

evident (e.g., Acs and Audretsch, 1993). Audretsch and Thurik (2001) interpret this change as indicating a shift from the *managed* to the *entrepreneurial economy*, which can be seen as an effect of globalization. The information and communication technology revolution made it possible to easily shift standardized economic activity to low-cost locations, especially to locations that are also relatively skill-intensive, i.e., countries in Central and Eastern Europe as well as Asia. These forces of globalization explain the loss of comparative advantage that was formerly based on the production factors of land, labor, and capital, as well as the exploitation of economies of scale. Therefore, Audretsch (2003) argues that high-wage countries now must focus on knowledge-based innovative economic activity if they want to secure both high wages and high levels of employment.

Unlike most other production factors, knowledge, due to its very nature, cannot be transferred costlessly across the globe, especially considering the high uncertainty of and high information asymmetries involved in its value. Knowledge is only partly codifiable (Polanyi, 1966) and therefore embodied in persons. Its successful transmission requires certain absorptive capacities of the recipient (Cohen and Levinthal, 1990) and frequent (face-to-face) interaction (von Hippel, 1994; Stephan, 1996). The costs of transmitting knowledge thus increase with distance which is supported by Jaffe et al. (1993) who traced knowledge flows via patent citations, which turned out to be geographically localized. Given the cumulative character of knowledge, these authors' results further suggest that regionally developed knowledge spurs the accumulation of further knowledge within the same region. In short, "proximity and location matter" (Audretsch and Feldman, 1996, p. 630).

In their *Theory of Knowledge Spillover Entrepreneurship*, Audretsch et al. (2006) argue that an environment with more knowledge will generate more entrepreneurial opportunities and, likewise, that an environment with less knowledge will generate fewer entrepreneurial opportunities.[2] Entrepreneurial activity then aims to exploit these opportunities and thus to commercialize knowledge. This could occur, for instance, through spin-off formation out of incumbent firms or research institutions when former employees commercialize the knowledge they acquired therein and that would otherwise remain uncommercialized (e.g., Agarwal et al., 2004; Klepper and Sleeper, 2005; Shane, 2004; Buenstorf, 2009). By increasing innovation, fostering competition, spurring diversity in sectors and firms, and offering a wider choice to consumers, entrepreneurship positively affects economic growth (Audretsch and Thurik, 2004; Fritsch, 2008). In other words,

[2] Linking the creation and pursuit of entrepreneurial opportunities to the broader economic context, Buenstorf (2007) emphasizes that opportunities often emerge as by-products of market competition, e.g., opportunities evolve (mostly unintended) from (other) people's prior activities in the market process.

"entrepreneurial activity is the conduit between investments in knowledge and economic growth at the particular location" (Audretsch, 2003, p. 38).

The above mechanism of entrepreneurship as a conduit for knowledge spillovers makes clear that positive effects on structural change and economic growth do not emanate from every kind of entrepreneurial activity (Santarelli and Vivarelli, 2007; Fritsch and Schroeter, 2009). Entrepreneurship is highly heterogeneous and can lead not only to Schumpeter's "creative destruction", but also to "market churning", which is reflected in the positive correlation between entry and exit rates found in many empirical studies (Bartelsman et al., 2005; Geroski, 1995). In particular, ill-equipped firms continuously enter and exit the market and these firms tend to be the recipients of, rather than contributors to, knowledge spillovers (Shaver and Flyer, 2000). Conversely, high-quality start-ups are argued to contribute most to economic performance (Fritsch, 2008; Fritsch and Schroeter, 2009). Characteristics of a start-up that give it the potential to be one of high quality and thus able to challenge incumbents, include, for example, the entrepreneur's qualifications, the start-up's innovativeness, and resource strength. Since these characteristics often go hand in hand,[3] high-quality entrepreneurship is in this thesis considered by the notion of "innovative entrepreneurship" (Wennekers and Thurik, 1999).

Policy responses to the entrepreneurial economy

Audretsch and Thurik (2001) posit that government policy plays a different role in an *entrepreneurial economy* compared to the part it acts in a *managed economy*. In a *managed economy*, policy intervention is needed to balance the tradeoff between efficiency (gained by increased concentration and economies of scale) and competition, and often takes the form of decentralizing policies like regulation, competition policy, and antitrust. In an *entrepreneurial economy*, however, this type of constraining policy is less relevant compared to *enabling policies* that target education, foster skills and human capital, and facilitate individual mobility, all of which are intended to enhance individuals' ability to start new and innovative firms (Audretsch and Thurik, 2001).

This goal can be pursued by various types of policy, ranging, e.g., from fiscal policy and labor market policy to innovation policy (Audretsch et al., 2007). For example, education policy might take a long-term view and be aimed toward skills deemed necessary to successful entrepreneurship. Macroeconomic policy, on the other hand, could be designed to have a more immediate effect by, for example, increasing the availability of

[3] For instance, human capital is needed to recognize innovative business opportunities (Ucbasaran et al, 2009) while resources such as financial capital are needed to pursue such opportunities successfully (e.g., Evans and Jovanovic, 1989; Cooper et al., 1994).

venture capital. Whereas the former impacts on background conditions and the latter on short-term conditions for entrepreneurship, the field of "entrepreneurship policy" emerged in the 1990s whose instruments aim to shape intermediate conditions for entrepreneurship (Hart, 2003a; Pages et al., 2003), i.e., they should impact within a period of years.

Entrepreneurship policies aim to create an entrepreneurial climate that will be conducive to successful entrepreneurial activity (Lundström and Stevenson, 2005). Lundström and Stevenson (2005) point out that entrepreneurship policy must focus on all phases of the individual entrepreneurial process, which is limited to the time 42 months after start-up. This time constraint corresponds to the definition of the Global Entrepreneurship Monitor and allows for the fact that new firms are especially vulnerable during their first up to five years in business (Minniti et al., 2005; Geroski, 1995).

Entrepreneurship policy often complements policy measures for small and medium enterprises (SMEs) that were established, mainly for political and social reasons, during the time of the *managed economy* (Audretsch and Beckmann, 2007). Lundström and Stevenson (2005) point out four major areas of divergence between the two types of policy. First, entrepreneurship policy focuses on individuals, whereas SME policy focuses on firms. Second, entrepreneurship policies are targeted at the early phases of the founding process (pre-start-up to early post-start-up); SME schemes and measures are intended to help established firms. Third, "soft" policy measures like mentoring and entrepreneurship promotion are popular elements of entrepreneurship policy; "hard" policy instruments (e.g., financial subsidies) are more characteristic of SME schemes and measures. Finally, entrepreneurship policy involves a wide range of support: educators, the media, and various public institutions all play a role in creating a favorable entrepreneurial environment. In contrast, SME policies make greater use of financial and fiscal incentives, which can be provided by a narrower set of economic institutions.

Of all the policy instruments analyzed in this thesis, only business assistance in the nascent phase of the entrepreneurial process can be regarded as a genuine instrument of entrepreneurship policy (business assistance schemes are evaluated in Chapter 3). Financial incentives in form of, e.g., grants, soft loans, and loan guarantees (examined in Chapter 2), as well as financial incentives for R&D (analyzed in Chapter 4 and 5), are more likely to be found in conjunction with SME or innovation policy. Furthermore, labor market policies offer start-up incentives and wage subsidies to nascent and young entrepreneurs. This thesis focuses on entrepreneurs in the founding process, that is, just before and just after the actual set-up of a venture. A useful discussion of *entrepreneurs* and *entrepreneurship* is not possible without first defining those terms since they have been specified in various ways.

In fact, defining entrepreneurship happens to be "one of the most difficult and intractable tasks" (Parker, 2004, p. 5). In this thesis, the notion of the entrepreneur is generally synonymous with the firm founder (if not stated otherwise). Likewise, persons who engage in the start-up of a venture (i.e., those active during the time between the first steps in the founding process up to the first business year) are referred to as "nascent entrepreneurs", and the founders of new firms (defined as those up to three business years old) are called "young entrepreneurs". Start-ups are eligible for a broad range of financial support schemes (analyzed in Chapters 2, 4, and 5). These financial programs form the relevant subsidy environment for start-ups and thus, in this thesis, are considered to be "entrepreneurship policies" in a wider sense.

Policy support along the founding process delivered in Thuringia

In East Germany, start-ups and small and medium enterprises have played a crucial role ever since German Reunification. Industrial disruption, asset stripping, and spin-off formation out of former state combines have resulted in an economic structure characterized by small companies (Legler et al., 2004). Therefore, policy instruments employed in Thuringia must be considered in the context of German Reunification and the transition process of the East German economy. Since the pool of firms in East Germany is still smaller than it is in West Germany, entrepreneurial activity can be seen as a mechanism of the catching-up process (DIW et al., 2003).[4]

In an attempt to foster regional economic development in East Germany, the investment allowance (*Investitionszulage*) constitutes the base of the subsidization. Eligible firms are legally entitled to this allowance, which has been in effect in East Germany since 1990. A great many East German companies have taken advantage of this program, i.e., they receive a tax-free cash settlement in the amount of the reimbursement rate (Heimpold, 1998). However, the average intensity of policy support is relatively low as long as the investment allowance is not combined with other kinds of subsidies (DIW et al., 2003). Similar to DIW et al. (2003), in this thesis, I do not consider the receipt of the investment allowance, but instead investigate only those support schemes that are delivered within the framework of labor market policy, innovation policy, SME policy, and entrepreneurship policy. These support policies for nascent and young entrepreneurs and their start-ups are usually discretionary in their administration, i.e., the funding authorities can decide whether or not to make an award and, if so, the level of award made (Heimpold, 1998). Compared to West Germany, East Germany and, especially, Thuringia shows a similar

[4] For an in-depth comparison of the role of entrepreneurship and the performance of new businesses in East and in West Germany during the 1990s, see Fritsch (2004).

structure of support schemes during the period under study in this thesis (1994–2006). However, the intensity of subsidization is generally higher in East Germany due to the special priority of East German applicants in some federal programs and the additional availability of the investment allowance. Furthermore, some programs focus exclusively on East German firms (Deutscher Bundestag, 2005; Koschatzky and Lo, 2005).

Table 1.1 contains an overview of the policy measures evaluated in the following chapters, their general eligibility criteria, and examples of available schemes in Thuringia. Table 1.1 also shows under which policy area the support scheme is offered. Since many of the policy support schemes described below can be combined, the individual policy take-up of founders and their start-ups can be diverse and may cover the entire founding process.

	Instruments	**Target group / eligibility**	**Exemplary programs available in Thuringia**	**Policy Area**			
				Labor Market Policy	**Innovation Policy**	**SME Policy**	**Entrepreneurship Policy**
Financial support schemes	▪ Soft loans ▪ Loan guarantees ▪ Equity financing	No general restriction	Various programs provided by *KfW*, *Thüringer Aufbaubank*, *Bürgschaftsbank Thüringen* (see Bundesregierung, 2008; Thüringer Aufbaubank, 2008)			x	
	Grants used as wage subsidies	No general restriction	*Einstellungszuschuss bei Neugründungen* (Hujer and Caliendo, 2003)	x			
	Grants as a temporary means of subsistence and for social security contributions	Start-ups by the un-employed	*Überbrückungsgeld, Existenzgründungszuschuss, Gründungszuschuss* (see Baumgartner and Caliendo, 2008)	x			x
	Grants as a temporary means of subsistence for nascent entrepreneurs	Academic spin-offs	*EXIST Seed / Gründerstipendium* (see Kulicke et al., 2006)		x		x
Business assistance	Public advisory services	No general restriction	*Thüringer Gründer Netzwerk* (see Chapter 3)				x
R&D support schemes	▪ Wage subsidies for R&D personnel ▪ R&D-project-specific subsidies ▪ Grants and equity financing for technology-oriented start-ups	Innovative start-ups / academic spin-offs	Various programs provided at the European, federal, and *Länder* level (see Koschatzky and Lo, 2005; Belitz et al., 2001)		x		x

Note: Whether a particular instrument can be attributed to a financial support scheme in general or to an R&D support scheme is not always obvious, e.g., in the case of policy instruments targeted at academic spin-offs.

Table 1.1: Policy measures available for entrepreneurs along the founding process

Financial support schemes. Financial support schemes are diverse. First, SME policy measures comprise mainly soft loans, loan guarantees, and equity financing. Soft loans provide better conditions to the debtor in terms of, e.g., interest rates and repayment obligations. Additionally, they can be often regarded as a mezzanine instrument. By

accepting less than customary collateral, this type of loan makes it possible for young and small enterprises to obtain financing.[5] Loan guarantee schemes are aimed at entrepreneurs who have no collateral and thus cannot signal their creditworthiness (Cowling and Mitchell, 2003). Semi-public institutions like the *Bürgschaftsbank Thüringen* offer loan guarantees to SMEs and therefore release the intermediate bank or the equity investor from part of its liability. Additionally, equity capital financing is made available to young firms by the *ERP-Startfonds* (Bundesregierung, 2008). Second, labor market policies have the dual-purpose goal of both encouraging the actual start-up of ventures by (formerly) unemployed persons and supporting the employment of (formerly) unemployed persons in new firms. Start-up incentives for the unemployed are made available via two different schemes, the *Existenzgründungszuschuss* (so called *Ich-AG*) and the *Überbrückungsgeld*.[6] Start-up incentives are not unique to German labor market policies; they can be found in most OECD countries (OECD, 2003). The *Einstellungszuschuss bei Neugründungen* provides a grant amounting to 50% of an employee's gross wage for at up to 12 months if the start-up fills a newly created job with a formerly unemployed person for an unlimited period (Hujer and Caliendo, 2003). Third, innovation policies and entrepreneurship policies are designed to encourage scientists to commercialize their research output via academic spin-offs. For example, *EXIST Seed*, which began in 2001, provides a financial backup for the pre-seed phase by financing half-time positions for academic nascent entrepreneurs (Kulicke and Schleinkofer, 2008).[7] Chapter 2 examines financial support schemes in more detail.

Business assistance. Publicly funded business assistance schemes are targeted at nascent and young entrepreneurs. They aim to assist nascent entrepreneurs in developing and growing viable businesses (European Commission, 2001). The services are organized as partnerships between government institutions and the chambers of industry and commerce; alternatively, the entrepreneur is given a voucher that can be used for private consulting.[8] A network of universities, business incubators, and the chambers of commerce (*Get-up /*

[5] Applications for soft loans are made through the borrower's bank. Therefore, the applicant must satisfy its bank as to the viability of the project such that the bank stands as guarantor for the loan vis-à-vis the funding authority (Heimpold, 1998).

[6] In 2006, these two schemes were merged and now constitute the *Gründungszuschuss* (Caliendo et al., 2008).

[7] In May 2007, *EXIST Seed* was replaced by *EXIST Gründerstipendium,* which introduced some minor modifications (Kulicke and Schleinkofer, 2008).

[8] The wide range of consulting initiatives with diverse responsibilities and complementary as well as substitutable foci has led to a shift in policy. Beginning in 2007, the federal level is solely responsible for advisory services to start-ups that are younger than five business years. Advisory services targeted at nascent entrepreneurs are under the responsibility of the *Länder* authorities (Bundesregierung, 2008).

Thüringer Gründer Netzwerk), established in 1998, concentrates on advisory services for the founders of technology-oriented and knowledge-based start-ups (TMWAI, 2003). Coaching is also integral part of *EXIST Seed*, a financial support program for academic spin-offs (Kulicke and Schleinkofer, 2008). Business assistance schemes are evaluated in Chapter 3.

R&D support schemes. R&D support schemes are mainly provided within the framework of innovation policy (Koschatzky and Lo, 2005) and involve discretionary grants directly funding R&D projects and R&D personnel (Czarnitzki et al., 2003). Between 1994 and 2000, public funds amounting to an average of 1,100 million Deutsche mark per year were spent on R&D support schemes in East Germany (Belitz et al., 2001). The German High-Tech Strategy, announced in 2006, led to considerable increases in R&D-related public expenditure (planned spending of € 14,600 million in the years 2006 through 2009). In addition to technology-specific funding, funds are given to improve conditions for innovative SMEs (planned budget of € 1,840 million between 2006 and 2009) and to support technology start-ups (planned budget of € 220 million between 2006 and 2009) (BMBF, 2006). Federal funds are complemented by support schemes of the German *Länder*. In 2007, Thuringia provided an additional € 28 million to fund research and innovation (Thüringer Aufbaubank, 2008). Research and development is subsidized with reimbursement rates ranging from 25% to 70%[9] (TMWA, 2008a).

Since the mid-1990s, new policy initiatives have emerged that aim to build up innovation networks (Audretsch and Beckmann, 2007). Policy support for setting up innovation networks is thought desirable because big companies – whose R&D activities play an important role in innovation systems – are largely absent in East Germany (Fritsch et al., 2009).[10] Programs such as *InnoRegio* and *BioRegio* intend to develop regional networks that have a distinguished economic profile and research reputation. Public funds are allocated within a "contest for cooperation" (Eickelpasch and Fritsch, 2005), in which funding authorities invite local actors to submit proposals for cooperative R&D, with the most promising proposals receiving public funding.[11] Since 2005, research-based high-opportunity start-ups can also apply for equity capital financing, which is provided by a partly state-financed fund (Bundesregierung, 2008). The set-up of the *High-tech*

[9] For cooperative R&D, subsidy rates can be from 40% to 80% (TMWA, 2008b).
[10] The few big companies that do exist in East Germany are mostly subsidiaries directed from headquarters in West Germany or abroad (Legler et al., 2004).
[11] For a more detailed overview on contest-oriented programs, see Eickelpasch and Fritsch (2005).

Gründerfonds can be attributed to initiatives from innovation policy and entrepreneurship policy. R&D support schemes as outlined here are investigated in Chapter 4 and 5.

Need for evaluation

The increased use and public funding of entrepreneurship support policies calls for rigorous evaluation to guide future policy-making. Such evaluation should assess the appropriateness of the measure, i.e., evaluators should scrutinize the economic rationale for the intervention. Furthermore, its effectiveness (Does the program achieve its objectives?) and its efficiency (Does the program achieve its objective at lower costs than other potential initiatives?) should be investigated (Lattimore et al., 1998). A key criterion for evaluating public policy measures is the concept of "additionality" (also known as "incrementality"). Additionality measures show the extent to which policy programs stimulate additional activity (e.g., additional employment) as opposed to subsidizing what would have taken place anyway (Hsu et al., 2009).

To date, policy schemes targeted at start-ups have mainly been monitored (Storey, 2000), i.e., the take-up of schemes and recipients' opinions have been documented. However, these studies do not compare the performance of assisted firms with that of nonassisted firms and thus cannot reveal whether the public policy measures are making any economic difference (i.e., their additionality). Storey (2000) particularly emphasizes the problem of selection bias arising due to founders' self-selection into assistance, as well as the potential bias that arises due to the selection of applicants "best" suited to a program by policymakers and program administrators (i.e., committee selection). Matching procedures have been developed to correct for selection bias in comparing assisted and nonassisted units on basis of identical initial positions described by, e.g., founders' ex-ante characteristics and industry. The differential performance is then attributed to the receipt of assistance. However, the validity of matching procedures crucially depends on being able to identify all relevant ex-ante characteristics that have an impact on both the probability of receiving assistance as well as on the respective outcome measure. If there are unobserved characteristics, the differential performance of assisted and nonassisted firms may be incorrectly attributed to the scheme, when it is, in fact, due to the unobserved factors (Caliendo, 2006). Furthermore, matching approaches can identify only direct effects of a policy scheme and have to abstract from indirect market effects or knowledge spillovers that might result from a particular policy intervention.[12]

[12] This assumption is commonly known as the *stable unit treatment value assumption* (Rubin, 1991).

Matching methods such as propensity score matching are popular in labor economics for evaluating labor market policies (Heckman et al., 1999). They are also applied in this thesis and are explained in more depth in Chapter 5. Storey (2000) argues that rigorous evaluations require extensive high-quality data that include information on both assisted and nonassisted units (Storey, 2000). Heckman et al. (1997) point out that matching methods substantially reduce bias when, first, information is collected using the same questionnaire for both the assisted and nonassisted firms and, second, both types of firms are drawn from the same random sample (see Michalopoulos et al. (2004) for experimental evidence in support of these arguments). Both requisites are fulfilled by the dataset at hand.

1.2 Research questions

The overarching aim of this thesis is to evaluate policy support for the entrepreneurial process. Specifically, this thesis is comprised of four papers that all empirically analyze policy support provided to nascent and young entrepreneurs in innovative industries in the East German state of Thuringia. The chapters are based on working papers that were presented at workshops of the research training group "The Economics of Innovative Change" (DFG-GK-1411) in Jena as well as at national and international conferences.[13]

More specifically, this thesis first discusses the rationale for the various policy interventions. Since positive external effects accruing from entrepreneurship and credit rationing are mainly put forward as a rationale for public policy intervention, Chapter 2 examines the evidence for these cases of market failure. This rather neoclassical perspective of rationales for policy intervention is supported by Schroeter (2009), who argues that the systems of innovation approach does not offer any additional rationale for policy intervention. Second, this thesis focuses on the allocation of policy measures across founders and their start-ups (Chapters 2, 3, and 4), taking a close look at the selection bias that arises from program selection and founders' self-selection into such programs. Third, Chapters 2, 3, and 5 analyze the effects of the various public support measures on

[13] The conferences include the G-Forum (12. G-Forum – Interdisziplinäre Jahreskonferenz zur Gründungsforschung, November 6–7, 2008, Dortmund), EMAEE 2009 (Sixth European Meeting on Applied Evolutionary Economics, May 21–23, 2009, Jena), AFSE Thematic Meeting ("Firms, Markets and Innovation", French Economic Association (AFSE), June 24–25, 2009, Sophia-Antipolis / France), FIRB-RISC Conference (Università Bocconi – KITeS "Research and Entrepreneurship in the Knowledge-Based Economy", September 7–8, 2009, Milan), Technology Transfer Society's Annual Meeting ("The Entrepreneurial Enterprise", October 1–2, 2009, Greensboro (NC / USA)), and DIME Workshop ("Regional Entrepreneurship as Source of Perpetuation and Change", October 15–17, 2009, Jena).

subsequent business performance. Additionally, founders' perceived usefulness of business assistance schemes serves as outcome measure in Chapter 3.

These three areas of policy evaluation are closely intertwined. Given highly heterogeneous start-up activity with regard to ex-ante characteristics such as founders' human and financial capital or start-ups' innovativeness, the rationale for policy intervention should determine the allocation of public funds. In turn, the allocation of policy measures should affect their effectiveness. If policymakers and program officials can more precisely target public funds to remedy market failure, the funding will be expected to be more effectively (and probably also more efficiently) spent.

In this context, various policy instruments are evaluated in this thesis: financial subsidies in general (Chapter 2), publicly financed business assistance (Chapter 3), and earmarked subsidies for R&D (Chapters 4 and 5). Due to a generally fragmented subsidy environment, the result of ever-changing policy schemes and funding institutions, it is not feasible to analyze single schemes as the number of observations would be insufficient for quantitative analyses. Therefore, the thesis takes an aggregate view of individual policy programs and analyzes a mix of different, albeit similar, schemes.

Different policy measures are available at different stages of the entrepreneurial process. The policy instruments evaluated in this thesis are either available at the nascent phase (i.e., the time between the first steps of the founding project and the beginning of the first business year) or within the first three business years. The different timing of policy measures also implies different recipients: that is, measures available within the first three business years are provided to the new firm itself, whereas business assistance schemes target the individual nascent entrepreneur.

Table 1.2 provides an overview of the policy instruments investigated in each chapter and also sets out when, along the founding process, each type of assistance has been evaluated.

Chapter		**Policy instrument**	**Timing of assistance within founding process**
Chapter 2	Subsidizing start-ups – Policy targeting and policy effectiveness	Financial subsidies, e.g., grants, soft loans, and loan guarantees	First three business years
Chapter 3	Building winners? Perceived usefulness and economic effects of public business assistance in the founding process	Business assistance	First steps in founding project until start of first business year
Chapter 4	Picking the winner? Empirical evidence on the targeting of R&D subsidies to start-ups	R&D subsidies	First three business years
Chapter 5	R&D subsidies to start-ups – Effective drivers of employment growth and patent output?	R&D subsidies	First three business years

Table 1.2: Overview of analyzed policy instruments (and the phases of the founding process in which they have been evaluated)

The evaluation of entrepreneurship policies in this thesis is based on data collected by the Thuringian Founder Study (*Thüringer Gründer Studie*). This interdisciplinary project on the success and failure of innovative start-ups collected various databases containing information on potential academic entrepreneurs, nascent entrepreneurs, and actual entrepreneurs. The empirical analyses presented below are based on face-to-face interviews with actual entrepreneurs (who might have closed their businesses meanwhile). The database draws from the commercial register of commercial and private companies (*Handelsregister, Abteilung A/B*) in the East German state of Thuringia and includes 2,971 start-ups in innovative industries registered between 1994 and 2006. Innovative industries, according to ZEW classification (Grupp and Legler, 2000), are those engaged in "advanced technology" and "technology-oriented services". The survey population consists of 4,215 founders (first registered owner-managers) who registered a new entry in the *Handelsregister* between 1994 and 2006. This design made it possible not only to interview founders of active companies but also founders of ventures that failed.

A random sample of 3,671 founders was selected from the survey population. Due to team start-ups, this corresponds to 2,604 start-ups in innovative industries. Between January and October 2008, 639 face-to-face interviews were conducted with solo entrepreneurs or with one member of a start-up team (a response rate of about 25%). On average, an interview took one and a half hours. The structured interviews covered a broad set of questions regarding sociodemographic and psychological data of the founder. Moreover, inquiry was made as to the founder's activities along the founding process. Retrospective data relating to events in the founder's life and business history were collected using guided recall.[14] In each of the following chapters, a different subsample of respondents is examined, the details of which can be found in the chapters themselves. The following subsections provide a brief overview of these chapters.

1.2.1 Targeting and effectiveness of financial support schemes

There is a wide range of financial subsidies (e.g., grants, soft loans, and loan guarantees) available to newly founded firms in Thuringia. Chapter 2 examines the rationale behind these financial support schemes, their overall allocation, and their effectiveness. Apart

[14] Specifically, we utilized mnemonic techniques drawn from the Life History Calendar method (Caspi et al., 1996). This method has been shown to collect more valid and reliable retrospective information than traditional questionnaires (Belli et al., 2004). We employed a study-specific version of the Life History Calendar, which is a data-collection tool developed by psychologists and sociologists. It is based on the principles of autobiographic memory. In a first step, we asked interviewees to fill in the timing of well-known life events, sequences, and transitions (e.g., marriage, birth of children, education, or career structure). In a second step, these events served as anchors for the recall of our retrospective study variables.

from labor market policies, most policy measures targeted at (nascent) entrepreneurs in the founding process are justified by alleged market failure resulting from positive external effects and capital market imperfections. On the one hand, start-ups are argued to lead to positive external effects (Audretsch and Thurik, 2004) since they give rise to knowledge spillovers, increase competition and contribute to diversity as they commercialize otherwise unused knowledge (Fritsch, 2008). On the other hand, credit market failure is put forward as a rationale for policy intervention. Asymmetric information between entrepreneurs and lenders is argued to restrict young and small firms' access to capital and thus hinder entrepreneurial performance (van Praag et al., 2005). However, the extent of potential credit rationing will differ across heterogeneous founders (Blumberg and Letterie, 2008). Similarly, positive external effects do not accrue from every entrepreneurial project (Santarelli and Vivarelli, 2007; Fritsch and Schroeter, 2009).

A literature review shows that theoretical reasoning and empirical evidence do not unambiguously reveal incidences of market failure (Auerswald, 2007; Parker, 2002). Therefore, the characteristics of start-ups are pointed out which are most likely affected by credit market failure and / or which are most likely to give rise to positive external effects. Positive external effects can be expected from innovative start-ups that are also more likely to be affected by credit rationing. The policy focus on remedying market failure leads to inconsistent recommendations for policy intervention. Whereas a rich endowment of human and financial capital has the potential to create positive external effects in the long-run, start-ups with these characteristics are not usually affected by capital market imperfections. The empirical analysis in Chapter 2 investigates whether the allocation of subsidies reflects a policy focus on addressing market failure occurrences. However, (multinomial) logistic regressions reveal that subsidies are *not* allocated toward those start-ups most likely affected by market failure. The lack of policy targeting can be explained by the existence of serious information problems in identifying ex-ante incidences of credit rationing and positive external effects. Furthermore, public choice considerations suggest that policymakers and program officials have an incentive to pursue a strategy of "picking the winner", i.e., to assist the most promising start-ups, so that they can take credit for success. However, this approach of "picking the winner" misses the opportunity to target market failure.

Furthermore, a lack of appropriate policy targeting will lead to ineffective and inefficient subsidization since start-ups that are not affected by market failure will obtain subsidies even though they do not need them. Propensity score matching suggests that, indeed, subsidized start-ups would have survived and thrived in any case, an indication of

deadweight losses of start-up subsidies. However, a lack of employment effects and no improvement of subsidized start-ups' credit rating does not imply a total lack of impact. Start-up subsidies might lead to market distortions, since subsidies give their recipients an artificial competitive edge, possibly allowing them to crowd out more efficient but unsubsidized start-ups (Santarelli and Vivarelli, 2007).

1.2.2 Public business assistance in the founding process

Publicly financed business assistance services that offer advice, coaching, and training to nascent entrepreneurs are a popular policy instrument in many countries of the world (Bosma et al., 2008). These measures are designed to help nascent founders develop and grow viable businesses. Given that start-up quality matters for inducing positive external effects in the long-run, the hope is to "build winners" who will later contribute to structural change and economic growth. Chapter 3 evaluates publicly funded business assistance schemes targeted at nascent entrepreneurs.[15]

The evaluation approach employed in Chapter 3 overcomes certain shortcomings of previous research on this topic. First, we explore the actual scope and intensity of business assistance, irrespective of which particular program is used. This procedure is followed because of the wide range of assistance schemes with different underlying funding authorities in Thuringia over the sample period (1994–2006), as well as strong self-selection into the kind and intensity of actual business assistance. A cluster analysis shows that if founders make use of business assistance at all, it takes the form of either intensive strategically-oriented support or one-off operational assistance. Second, we analyze the predictors of policy take-up and perceived usefulness of business assistance. Our results suggest that a lack of entrepreneurial resources is behind both the decision to take advantage of comprehensive business assistance and the perception that such assistance has been useful. Low entrepreneurial resources are defined as a lack of entrepreneurial experience or role models, a lack of social capital, or a weak entrepreneurial personality profile.

However, business assistance schemes should be considered successful only when they help weak nascent founders start and grow economically viable ventures. This implies that business assistance must sustainably compensate for and develop the entrepreneurial resources that are argued to impact entrepreneurial success at the micro level (e.g., Markman and Baron, 2003) as well as foster structural change and economic growth at the macro level (e.g., Fritsch and Schroeter, 2009), because the positive external effects that

[15] Chapter 3 is based on a working paper written in conjunction with Martin Obschonka.

accrue from innovative economically viable start-ups are the main justification for the public provision of business assistance. Therefore, in a third step, we assess the economic impact of business assistance by studying subsequent business performance employing propensity score matching, which corrects for selection bias. We do not find any effect of business assistance on subsequent business performance as proxied by initial capital (at the beginning of the first business year), employment, and credit rating (in the third business year). Further research is desirable to track nascent entrepreneurs along the entire founding process; our data provide information only about the founding process of young entrepreneurs, i.e., those founders who successfully completed the nascent phase (survivor bias).

1.2.3 Targeting of R&D subsidies

The allocation of R&D subsidies to start-ups is investigated in Chapter 4.[16] Neo-classical as well as Neo-Schumpeterian approaches argue that research and development (R&D) in new firms is affected by incidences of market failure or system failure, respectively. If entrepreneurs cannot raise the capital for R&D to (reasonable) costs or if they cannot appropriate the returns from R&D, they will conduct less R&D than is socially optimal. R&D subsidies thus aim to reduce these costs and risks in order to induce higher R&D activity, so called "additionality". Therefore, the projects that should be subsidized are those that promise high social returns but that, in the absence of a subsidy, would not be undertaken because the expected private returns are too low. Hence, projects expected to be privately profitable and that, therefore, will be undertaken anyway, should not receive public support. Subsidies are simply transfer payments for these inframarginal projects and will not lead to additional R&D (Stiglitz and Wallsten, 2000).

Given fundamental information problems in identifying incidences of market failure (or system failure) ex-ante, we argue that policy is targeted toward the ex-ante most promising start-ups, that is, a strategy of "picking the winner" is pursued. Prior research shows that start-ups' innovativeness and resource strength (in terms of human and financial capital), as well as founders' growth ambitions, are early indicators of start-up success (Cooper et al., 1994; Wiklund and Shepherd, 2003). A policy targeted at these start-ups will minimize market distortions arising from subsidizing genuinely non-efficient start-ups (Shane, 2009). Furthermore, public choice considerations suggest a policy focus on promising start-ups because such reduces the risk for policymakers and program officials of having to justify their subsidization of failed projects.

[16] Chapter 4 is based on a joint working paper written in conjunction with Uwe Cantner.

Our empirical analyses provide ambiguous support for the above argument. R&D subsidies are given to start-ups with innovative business ideas, especially academic spin-offs. On the other hand, however, the ambitions and the patent stock of the founder have no influence on the receipt of R&D subsidies. This pattern of support is attributable not only to the decisions of policymakers and program officials but also to self-selection of founders, which can be at least partially explained by the costs incurred by founders in applying for policy programs.

Insights into the overall allocation of R&D subsidies do not reveal anything about policy effectiveness and efficiency, but they are an important prerequisite for evaluating effectiveness (which is done in Chapter 5) since non-random subsidization constitutes a selection bias. The implied difficulties of policy targeting give rise to some doubt as to the advisability of massively subsidizing private R&D. Policy schemes run the risk of blocking the emergence of a private market for R&D (e.g., venture capital). Ironically, therefore, providing public subsidies for R&D may very well guarantee the existence of such subsidies in the future.

1.2.4 Effectiveness of R&D subsidies

To date, the evidence is mixed as to the effectiveness of R&D subsidies, a situation possibly due to the great diversity of schemes evaluated and methodologies used in conducting the evaluations. Although there is a fair amount of work on R&D subsidies to established firms, subsidies to start-ups have not yet been analyzed,[17] even though public subsidies for R&D are widespread among new firms that conduct R&D within their first three business years: 42.5% of these start-ups receive R&D subsidies. Chapter 5 investigates the effectiveness of R&D subsidies to start-ups.[18] Taking an aggregate view rather than evaluating a single program, we estimate the impact of R&D subsidies on start-ups' employment growth and patent output. Employment growth is an input-oriented indicator of additional R&D activity. Since salaries for scientists and engineers constitute the bulk of R&D expenditure in small firms (Hall, 2002), public funds should especially lead to increased R&D employment. Conversely, patents are a popular output-oriented measure of the invention process and can be regarded as a proxy for positive external effects.

We conduct propensity score matching to address the selection bias between subsidized and non-subsidized start-ups (as analyzed in Chapter 4). We find that R&D

[17] One exception is Koga (2005), who analyzes the effectiveness of R&D schemes for young firms.
[18] The underlying working paper of Chapter 5 is co-authored with Uwe Cantner.

subsidies lead to an increase in employment growth of about 66%. Furthermore, subsidized start-ups show a 2.8 times higher patent output. These estimates provide evidence for the additionality of R&D subsidies within the first three business years. This evidence is bolstered by the self-report of windfall gains. We asked each founder of a start-up that received an R&D subsidy: “Would you have been engaged in R&D anyway?” Only 19.2% answered “yes, readily”, 47.5% said “yes, perhaps or on a reduced scale”, and the remaining third (32.3%) said “no”. The last two responses point to the additionality of R&D subsidies.

The analysis also highlights a special group of academic spin-offs that excels in the novelty business ideas and patent activity. For some of these high-tech start-ups, no non-subsidized counterparts can be found. This might be attributed to the policy focus on academic spin-offs, which has led to a successful targeting of R&D support schemes. However, these exceptional academic spin-offs do not excel with respect to employment growth, which points to the early development of the spin-offs with respect to the marketability of their products.

2. Subsidizing start-ups – Policy targeting and policy effectiveness[19]

2.1 Introduction

Entrepreneurship plays an increasingly prominent role in both academic and policy circles. It is regarded as the driving force behind structural change that links investments in knowledge with economic growth (Audretsch and Thurik, 2001). The increased role of new and small enterprises has led to an increase in entrepreneurship policies aimed at encouraging more people to consider entrepreneurship as an option and act on a business idea (Lundström and Stevenson, 2005). Especially in East Germany, which still lags behind West Germany in all economic performance indicators, policymakers pin their hopes on various policy instruments (Bundesregierung, 2007). Although entrepreneurship policies focus on soft policy instruments like consulting services, the overall subsidy environment is dominated by soft loans, loan guarantees, and grants – offering start-ups an extensive choice of support (Thüringer Aufbaubank, 2008). The policy focus on hard policy instruments is also reflected in the allocation of public funds. For example, although 5.3 million Euro were allocated to public initiatives offering consulting services to Thuringian business founders in 2005 and 2006, direct financial subsidies for business set-ups in Thuringia amounted to more than 104 million Euro during that same period (TMWTA, 2007).[20]

Apart from labor market policies, policy intervention in favor of nascent and young entrepreneurs and their start-ups is traditionally justified by presumed market failure. First, positive externalities accruing from entrepreneurship create a disparity in the valuation of (potential) entrepreneurs by investors and policymakers (Audretsch et al., 2007). Whereas individual entrepreneurs and investors are only interested in single firm performance, policymakers should be more interested to allow for positive external effects. Second, policy intervention aims at remedying asymmetric information, which has been argued to restrict young and small firms' access to capital and thus hinder entrepreneurial performance (van Praag et al., 2005). Start-ups differ in both their ex-ante characteristics, such as economic and environmental features, and by the individual characteristics of their founders and, therefore, capital constraints will also vary (Blumberg and Letterie, 2008). Similarly, positive external effects do not accrue from every entrepreneurial project (Santarelli and Vivarelli, 2007; Fritsch and Schroeter, 2009).

[19] This chapter is based on Kösters (2009).

[20] The latter figure comprises only those funds from the *Gemeinschaftsaufgabe "Verbesserung der regionalen Wirtschaftsstruktur" (GA)* (TMWTA, 2007), which are allocated for genuine business start-ups and for setting up new branches of existing businesses. Although the *GA* is the most important scheme of German regional policy, there are other programs that offer soft loans, loan guarantees, and grants to Thuringian start-ups (TMWTA, 2007; Thüringer Aufbaubank, 2008).

The identification of market failures that hamper the start-up and growth of otherwise efficient ventures is thus a necessary but not sufficient condition for effective and efficient policy intervention. When deciding on policy intervention, policymakers should be aware of the market distortions that can result from subsidization. Market distortions arise because policymakers and program officials do not have complete information which would allow to fund marginal projects. In the absence of complete information, public support schemes give subsidized start-ups an artificial competitive edge that could lead to their substitution for other start-ups or incumbents that are ex-ante more efficient but nonsubsidized. In general, the distortions arising from substitution effects are larger than those resulting from deadweight losses: not only is public money spent ineffectively, but the subsidy enables the subsidized start-up to crowd out a potentially more efficient firm (Santarelli and Vivarelli, 2007).

The start-up subsidy environment is diverse. Various subsidization policies coexist, leading to a broad range of support schemes administered by a similarly broad range of agencies (TMWTA, 2007). In this study, I do not examine a specific scheme but take an aggregate view of the receipt of any kind of financial subsidy within the first three business years of a start-up. I use data from 162 start-ups in innovative industries in the East German state of Thuringia.[21] More than 45% of these start-ups make use of financial subsidies which are primarily given as soft loans, loan guarantees, or grants. A broad set of ex-ante characteristics allows me to analyze the allocation of subsidies. Does the allocation of subsidies provide evidence of policy geared toward positive external effects? Or is the policy instead focused on remedying capital market imperfections? The answer to both questions turns out to be "no". Logistic regressions reveal that the allocation of subsidies is neither based on the rationale of positive external effects nor on subsidies' potential to cure capital market imperfections. Instead, the inconsistent allocation reveals likely substitution effects. Moreover, I apply propensity score matching to identify the causal effect of subsidization and find neither a significant effect of subsidies on business survival nor on employment growth. The matching results suggest that subsidized start-ups would have survived and thrived in any case and thus indicate deadweight losses. These findings highlight the relevance of information and incentive problems when designing and allocating start-up subsidies, since policy targeting affects potential market distortions and policy effectiveness.

[21] This subset of a larger survey does not contain start-ups that engage in R&D within the first three business years, since they are eligible for R&D subsidies whose effectiveness is examined in Chapter 5. R&D subsidies have been found to be highly effective, leading to an increase in employment growth of about 66% and a rise in patent output of 184%. However, start-ups that do not engage in R&D are also widely subsidized and therefore justify a separate analysis.

The remainder of the article is structured as follows. The next section contains a review of the literature that examines the market failure argument to justify start-up subsidies. Ex-ante characteristics of start-ups that are most likely to be affected by market failure are derived and the market distortions resulting from policy intervention are discussed. In the empirical analysis (Section 2.3), a logistic regression first investigates the characteristics of subsidized start-ups. Second, I employ propensity score matching to examine the effectiveness of financial subsidies in the survival and growth of start-ups. Section 2.4 concludes.

2.2 Rationale for (no) policy intervention

Incidences of market failure constitute a necessary but not sufficient condition for policy intervention. Market failure arises from a lacking appropriability of returns from entrepreneurial activity (Section 2.1) as well as from asymmetric information leading to capital market imperfections (Section 2.2). In these two sections, the ex-ante characteristics of start-ups that will likely lead to market failure, and that thus should guide subsidy allocation, are derived. Section 2.3 then summarizes these conjectures for subsidy allocation and discusses the implications of policy targeting for market distortions and policy effectiveness.

2.2.1 Positive external effects

Audretsch and Thurik (2004) identify three channels through which entrepreneurial activity has an impact on economic growth. First, entrepreneurship spurs knowledge spillovers, since it is a mechanism by which knowledge – captured in founders and their business ideas – is commercialized. According to Marshall (1890), other firms of that particular industry benefit from these knowledge spillovers (amongst others) when they are geographically concentrated. Second, entrepreneurship is accompanied by firm entry, exit, and turnover, which implies increased competition. Increased competition will be more conducive to knowledge externalities (Jacobs, 1969; Porter, 1990) because it increases the pressure to innovate. Third, a start-up contributes to diversity since it is an attempt to commercialize knowledge that otherwise would have remained uncommercialized (Audretsch and Keilbach, 2004). Increased diversity among firms and a higher variety of enterprises are argued to enhance regional growth since knowledge spillovers external to an industry are believed to be the most valuable kind (Jacobs, 1969; Glaeser et al., 1992). However, industry characteristics can create a tradeoff between the benefits of diversity

resulting from a high number of small firms and large firms' advantage of appropriating the returns from innovative activity (Cohen and Klepper, 1992). For instance, an industry structure dominated by many small firms will be socially beneficial if the respective technology is characterized by a number of different approaches to innovation and if appropriability can be ensured by rapid growth, licensing, and other mechanisms.

The above mechanisms make clear that entrepreneurship does not always contribute to economic growth. Santarelli and Vivarelli (2007) point out that new firm formation leads not only to Schumpeterian "creative destruction", but also to "market churning", which occurs when ill-equipped firms continuously enter and exit the market. Market churning is reflected in the positive correlation between entry and exit rates that is found in many empirical studies (Bartelsman et al., 2005; Geroski, 1995). High-quality start-ups are argued to contribute most to economic performance (Fritsch, 2008). The characteristics and impact of these high-quality start-ups include the following. First, *innovative* start-ups commercialize knowledge and thus give rise to knowledge spillovers. Their innovations imply greater variety for customers and better matching customer preferences and will, ultimately, result in higher utility for customers (Fritsch, 2008). Innovative start-ups are additionally characterized by a *high endowment of human capital* because a rich knowledge base enables the recognition and exploitation of high-quality entrepreneurial opportunities (Ucbasaran et al., 2009; Baron, 2006). Entrepreneurs' human capital positively affects the post-entry performances of their start-ups and will thus contribute to static and dynamic efficiency (Colombo and Grilli, 2005; Fritsch, 2008). The empirical evidence supports the view that innovative start-ups and/or start-ups with a high endowment of human capital make a strong contribution to structural change (Acs and Mueller, 2008; Baptista and Preto, 2006). Conversely, less innovative start-ups and start-ups with lower endowments of human capital are rather recipients rather than contributors to knowledge spillovers (Shaver and Flyer, 2000).

Second, start-ups with superior *financial resources* have higher survival chances and better performance (Cooper et al., 1994; Holtz-Eakin et al., 1994; Brüderl et al., 1992). Cooper et al. (1994) argue that initial capital has both direct and indirect impacts on performance. As a direct effect, financial resources allow start-ups to pursue more capital-intensive strategies (which might be more efficient and better protected from imitation) and to realize venture growth. Furthermore, financial resources constitute a buffer against random shocks. Indirectly, superior financial resources might reflect higher endowments of human capital and more extensive planning that has attracted outside lenders and investors. Start-ups with high endowments of financial capital are thus able to mount a greater

challenge to incumbents and, in this way, will ensure efficiency and stimulate productivity (Fritsch, 2008).

Third, the rare phenomenon of *high-growth entrepreneurship* accounts disproportionately for innovative change and economic growth (Autio, 2005; Henrekson and Johansson, 2008; Wong et al., 2005; Stam et al., 2009). There are various definitions of and terms used to describe high-growth entrepreneurship (Buss, 2002), ranging from "gazelles" (Birch, 1979) to "high-expectation" (Autio, 2005) and "ambitious" start-ups (Stam et al., 2009).[22] All these definitions, though, have in common that they combine the above characteristics (innovativeness, rich endowment with human capital, and financial capital) with an ambition to grow.

To sum up, the impact of heterogeneous start-up activity on economic performance is ambiguous. Nevertheless, there is some evidence that *innovative, well-equipped (in terms of a rich knowledge base* and *financial strength)*, and *growth-oriented* start-ups yield positive external effects in the long run.[23] This is especially true if they are started in a supportive regional environment (Fritsch, 2008). For instance, Fritsch and Mueller (2004) find that new business formation has a particularly strong impact on employment change in agglomerations and high-productivity regions, whereas even a negative impact can be observed in regions with low productivity. Entrepreneurial activity varies not only within but across countries. Cross-country studies find that the impact of entrepreneurial activity on a country's innovative capacity (Wennekers et al., 2005), as well as on its macro-economic performance, increases with per capita income (Thurik et al., 2008; van Stel et al., 2005; Stam et al., 2009). This work thus suggests that entrepreneurship plays different roles in different countries, depending on their stage of economic development. It is important to note, also, that positive external effects only become apparent in the long run: the estimated time lag between entrepreneurial activity and subsequent economic performance can be as much as 10 years (Fritsch and Mueller, 2004; Thurik et al., 2008; van Stel and Suddle, 2007).

[22] For instance, high-potential innovative start-ups are defined by the Global Entrepreneurship Monitor as ventures that fulfill the following criteria: (1) start-up aims to employ at least 20 employees in five years; (2) the start-up indicates at least some market creation impact; (3) the start-up targets international markets to the extent that at least one-fourth of its customer base is abroad; and (4) the applied technologies had not been widely available more than a year ago (Wong et al., 2005).

[23] Even failed start-ups may give rise to positive externalities since they may have challenged incumbents and given rise to knowledge externalities, e.g., when the ideas and experiences of their former employees become an integral part of products made by successful firms (Audretsch et al., 2007; Fritsch, 2008). Similarly, Buenstorf and Fornahl (2009) suggest that temporarily successful start-ups could have lasting impact on regional development. They find that *Intershop*, a software start-up from Jena which drastically declined after 2000, initiated a software cluster by spawning spin-offs, attracting human capital to the region and inducing investment in software-related infrastructure.

More generally, Auerswald (2007) questions whether potential social returns from innovative entrepreneurial activity are a suitable rationale for policy intervention. He argues that innovative start-ups can give rise to knowledge spillovers but, at the same time, can reap considerable private returns from their innovation due to legal protection in the product market or because of high entry costs for potential imitators. Furthermore, the social benefits accruing from innovative entrepreneurship are uncertain and will generally lie far in the future. They are thus unlikely to much of a motivating factor in the entrepreneur's decision-making process. Therefore, Auerswald argues that information asymmetries affect (technology) entrepreneurship far more than positive external effects do. I thus turn next to capital constraints, which result from information asymmetries.

2.2.2 Capital constraints

Information imperfections leading to credit market failure are accused of creating a barrier to the acquisition of loan capital by nascent and young entrepreneurs. If this is indeed the case, such imperfections thus impede the actual start-up of a venture as well as jeopardize both its survival and growth. Stiglitz and Weiss (1981) argue that credit rationing characterizes the equilibrium state if banks cannot observe borrowers' risks. In the presence of imperfect information, the price (i.e., the interest rate) affects the nature of the transaction since increasing interest rates or collateral requirements attract riskier entrepreneurs (adverse selection) and induce borrowers to invest in riskier projects (moral hazard). Therefore, it may not be profitable for a bank to raise interest rates to clear the market, but it will rather limit the number of loans. In other words, credit rationing implies that banks grant credit only to a fraction of observationally identical projects. A project could still be denied credit even if it offered to pay a higher interest rate (Parker, 2002). The likelihood of credit rationing is, ceteris paribus, higher for start-ups and small firms because the fixed costs of granting and servicing loans lower the profit margin on lending to smaller businesses. Furthermore, according to Blumberg and Letterie (2008), the fewer the number of repeat transactions, the less the incentive for business analysts to collect information and the fewer the instruments with which start-ups can signal their credibility. Asymmetric information can be resolved by commitments such as collateral, the investment of own resources, and the provision of costly information that increase the credibility of the credit application. Additionally, founders can signal good prospects for later business success since banks are interested in long-term relationships with successful start-ups (Storey, 1993; Blumberg and Letterie, 2008). However, the theoretical case for credit rationing is ambiguous. De Meza and Webb (1987) diagnose the problem as

overlending rather than credit rationing when just slightly modifying the assumptions of the Stiglitz and Weiss model.[24] This theoretical debate has spawned a huge body of empirical literature analyzing the impact of capital constraints on the decision to start a venture as well as on the performance of newborn firms (Cressy, 2002; van Praag et al., 2005).

The extent of credit constraint will vary across heterogeneous start-ups, depending on individual characteristics of the founders and their start-ups (Blumberg and Letterie, 2008). First, *innovative start-ups* are argued to be particularly affected by asymmetric information in capital markets (Colombo and Grilli, 2007; Carpenter and Petersen, 2002; Guiso, 1998) since the returns from innovative activity are uncertain, highly skewed, and difficult for outsiders to evaluate. Additionally, investment in innovative activity mainly encompasses salaries and the acquisition of highly specialized assets, neither of which provide much collateral value in the event of failure (Carpenter and Petersen, 2002). Parker and van Praag (2006) find that entrepreneurs in capital-intensive industries are significantly more likely to be affected by credit constraints. Since this effect is in addition to the scale effect from higher capital needs, they argue that banks' screening errors are systematically greater in industries in which production techniques are more complicated and involve intangible capital. Still, innovative start-ups might self-select into other forms of lending (Åstebro and Bernhardt, 2003; Carpenter and Petersen, 2002), therefore easing potential capital constraints. Carpenter and Petersen (2002) argue that equity financing has a number of advantages over debt for highly innovative firms since equity financing allows unbounded upside returns for investors. Furthermore, it neither increases a start-up's probability of financial distress nor does it induce managers to engage in excessively risky projects. However, Lerner (2002) points to the limited scope of the venture capital industry, which backs only a tiny fraction of technology-oriented start-ups.

Ventures started by founders with limited *financial resources* might be a second group that suffers from capital constraints. Poor people's restricted access to credit markets can be explained by their inability to commit themselves by investing own resources. The commitment of personal wealth is another important mechanism for mitigating asymmetric information (Blumberg and Letterie, 2008). This implies that collateral-based lending tends to discriminate against the poor, regardless of the quality of the project itself (Cowling and Mitchell, 2003). Van Praag et al. (2005) summarize studies that relate personal wealth to various performance measures of entrepreneurial ventures, all of which finds either a

[24] De Meza and Webb (1987) allow the expected return to vary across firms, whereas Stiglitz and Weiss (1981) assume that all firms have the same expected return but that the dispersion of returns is different.

positive or no impact of assets on performance. This literature can be traced back to Evans and Jovanovic (1989), who estimate that the capital stock that entrepreneurs can invest is restricted to 1.5-fold of their initial assets. In this way, liquidity constraints prevent people with few assets from either engaging in entrepreneurship altogether, or force them to start a business with less than the optimal amount of capital. On the other hand, however, a lack of personal assets may suggest a lack of human capital, implying, in turn, deficient economic viability of the venture (Parker and van Praag, 2006). This endogeneity problem is solved when the relationship between windfall gains (e.g., inheritances or lottery prizes) and performance is analyzed. Nevertheless, such studies still point to the presence of liquidity constraints, since the receipt of windfall gains increases the probability of becoming self-employed and enhances start-up performance (Lindh and Ohlsson, 1996; Taylor, 2001, Holtz-Eakin et al., 1994).

Finally, capital constraints might particularly affect start-ups endowed with *low human capital*, since they are deprived of an important signaling mechanism that helps overcome asymmetric information. Low human capital implies both a limited chance of success of the start-up and low post-failure earning capacity. However, a positive assessment of the potential for success and the consequently increased probability that the founder will be able to repay the debt is crucial in overcoming a bank's reluctance to lend (Blumberg and Letterie, 2008). Empirically, Åstebro and Bernhardt (2005), as well as Parker and van Praag (2006), show that higher endowments of human capital lower initial capital constraints. Åstebro and Bernhardt (2005) find this effect to be nonlinear, that is, a high-school diploma offsets the credit constraint, but higher levels of education have only limited impact on reducing capital constraints. In contrast to the studies discussed above, Cressy (1996) finds that the positive relation between financial capital and survival disappears once human capital is controlled for. This finding throws doubt on the case for credit rationing since financing decisions made on the basis of observable characteristics such as human capital merely reflect the bank's desire to allocate funds wisely.

In summary, although credit rationing cannot be rejected on theoretical grounds, the empirical evidence for it appears to be rather limited at best, no doubt in part due to the difficulty of identifying credit rationing. On the one hand, there are at least two reasons why a positive effect of financial variables on performance does not necessarily imply credit rationing (Parker, 2002; van Praag et al., 2005). First, these studies make the initial assumption that there is no direct way of obtaining external finance (van Praag et al., 2005). Second, the problem of endogeneity is often neglected. Endogeneity arises because

assets could have been accumulated by superior entrepreneurial ability (human capital), which is in turn responsible for above-average entrepreneurial performance. On the other hand, survey studies measure the extent of credit constraints more directly. Levenson and Willard (2002) analyze survey data from the United States in the late 1980s and find that 6.36% firms are credit-rationed, which is stated to be an outside estimate because this figure includes discouraged borrowers and unsuccessful applicants who might not be creditworthy. Using Dutch survey data from the mid-1990s, Parker and Van Praag (2006) find that 19% of new founders obtained less finance than they required. However, self-reports of credit constraints bear the risk of bias, since entrepreneurs might see the lack of external finance as the main cause of their problems, whereas it might be just a symptom of other deficiencies of the start-up (Santarelli and Vivarelli, 2007; Parker, 2002). Additionally, empirical studies differ in their definitions of credit rationing.[25] Parker (2002) thus questions whether credit rationing is a suitable rationale for policy intervention and points to positive external effects of entrepreneurship, thereby contradicting Auerswald (2007). Having in mind data and measurement limitations, the literature summarized above nevertheless suggests that *innovative* start-ups as well as start-ups with *few financial resources* and *low endowments of human capital* are more likely to be affected by capital constraints.

2.2.3 Targeting of policy intervention

Although the previous subsections have shown that the existence (and if so the extent) of positive external effects and capital market imperfections is disputed (Auerswald, 2007; Parker, 2002), their existence still constitute a necessary condition for policy intervention. However, the information requirements for identifying incidences of market failure are extremely demanding. Not only do policymakers and funding agencies need to know social and private returns ex-ante in order to discern external effects, they also have to identify the information asymmetries that lead to capital market imperfections. Incidences of market failure have to be identified ex-ante for every single project that applies for subsidization. If exact policy targeting of the individual marginal entrepreneur is not possible, it is questionable whether policy intervention will do any good at all. Subsidies give their recipients an artificial competitive edge and might thus lower the intrinsic

[25] For instance, Parker (2002) defines credit rationing as a situation where some entrepreneurs are denied credit although they are willing to pay a higher interest rate and even though they are observationally identical to entrepreneurs who receive credit. In contrast, Evans and Jovanovich (1989) estimate the multiple of the founder's assets that can be devoted to the business. This multiple is then used as a measure of the degree of liquidity constraints. For an overview of definitions of credit rationing, see Jaffee and Stiglitz (1990).

difference between ex-ante less efficient and more efficient start-ups. In this way, subsidization distorts market selection as well as the learning processes inherent in a new business. Market selection remains the crucial mechanism for singling out innovative entrepreneurship from less viable start-ups and ridding the market of less efficient incumbent firms (Fritsch, 2008; Santarelli and Vivarelli, 2007). Moreover, actual subsidy allocation has implications for policy effectiveness. If policy does succeed in targeting the marginal entrepreneur, subsidies will be granted where most needed and thus will produce the best results, leading to high effectiveness. Additionally, a specific policy focus will increase efficiency because it allows realizing the most economic impact with the least amount of funds (Stam et al., 2009; Bridge et al., 2003).

Given the implications of policy targeting, the actual allocation of start-up subsidies is of crucial importance in assessing likely market distortions and evaluating policy effectiveness and efficiency. Assuming that the primary policy aim is addressing positive external effects (cf. Section 2.2.1), policy should primarily support innovative founders and founders with high endowments of human and financial capital. Potential high-growth entrepreneurship should be especially targeted. If, on the other hand, the primary policy aim is addressing capital market imperfections (cf. Section 2.2.2), policy should be designed chiefly to support, again, innovative founders, but this time also those founders with low human capital and a lack of financial resources. Table 2.1 summarizes the expected patterns of correlation between start-up characteristics and the receipt of subsidies depending on whether the policy goal is creation of positive external effects or, alternatively, addressing capital market imperfections. It is unclear whether high-growth entrepreneurship is affected by capital market imperfections, since relationship banking and private venture capital firms can be expected to circumvent this problem (Binks and Ennew, 1996; Carpenter and Petersen, 2002). Therefore, this relation is denoted with a question mark. Apart from innovative entrepreneurship, potential sources of market failure thus point to diverging target groups of policy initiatives.

	Policy targeting: Expected signs according to policy goal	
	Positive external effects	**Capital market imperfections**
Innovativeness	+	+
High-growth entrepreneurship	+	**?**
Human capital	+	–
Financial resources	+	–

Table 2.1: Start-up characteristics and expected policy support according to policy goal

Policy targeting that aims to realize positive external effects has the positive side-effect of minimizing the risk of substitution effects because it implies a policy focus on the ex-ante most promising start-ups – in terms of both social and private returns (Santarelli and Vivarelli, 2007; Shane, 2009). If policy intervention is successful in "picking winners", subsidies will not protect inefficient start-ups from market competition. Therefore, this policy strategy is least likely to interfere with market selection, which forces inefficient start-ups out of business. However, if policymakers cannot sufficiently distinguish between social returns and private returns ex-ante, a policy focus on innovative high-growth start-ups that are endowed with superior human and financial capital runs the risk of enormous deadweight losses because these firms might survive and thrive regardless of whether they receive a subsidy (Santarelli and Vivarelli, 2007).

In the next section, I investigate empirically whether policy allocation follows the rationale of positive external effects or is based on addressing capital market imperfections. Alternatively, the difficulties in quantifying social and private returns and identifying information imperfections ex-ante might blur the actual targeting of policies (Stiglitz and Wallsten, 2000). Therefore, it could turn out that the diverse subsidy environment, with its myriad programs, engages in no coherent targeting strategy whatsoever. The use of start-up incentives as labor market instrument could also blur a policy targeting towards incidences of market failure. However, subsidization which does not target incidences of market failure will distort market selection and is likely to be ineffective and inefficient.

2.3. Empirical analysis

In the empirical analysis, I first examine the allocation of subsidies to start-ups within their first three business years. The logistic regressions shall indicate whether policy targeting either addresses positive external effects potentially accruing from entrepreneurship or focuses on alleged capital market imperfections resulting from asymmetric information. Additionally, insights about actual policy targeting shed light on the likelihood of market distortions arising from substitution effects. In a second step, I analyze the effectiveness of subsidization with respect to employment growth and survival. To detect potential deadweight losses, I employ propensity score matching.

2.3.1 The data

Data for this study were collected by the Thuringian Founder Study (*Thüringer Gründer Studie*), an interdisciplinary project on the success and failure of innovative start-ups in the East German state of Thuringia. The survey population consists of 4,215 founders (first-registered owner-managers) who registered 2,971 start-ups in innovative industries in the Thuringian *Handelsregister* between 1994 and 2006. Innovative industries, according to ZEW classification (Grupp and Legler, 2000), encompass "advanced technology" and "technology-oriented services". This design made it possible to interview not only founders of active companies but also founders of ventures that had failed. From the survey population, we selected a random sample of 3,671 start-up founders. Due to team start-ups, this corresponds to 2,604 start-ups in innovative industries. Between January and October 2008, we conducted 639 face-to-face interviews with solo entrepreneurs or with one member of a start-up team (a response rate of about 25%).

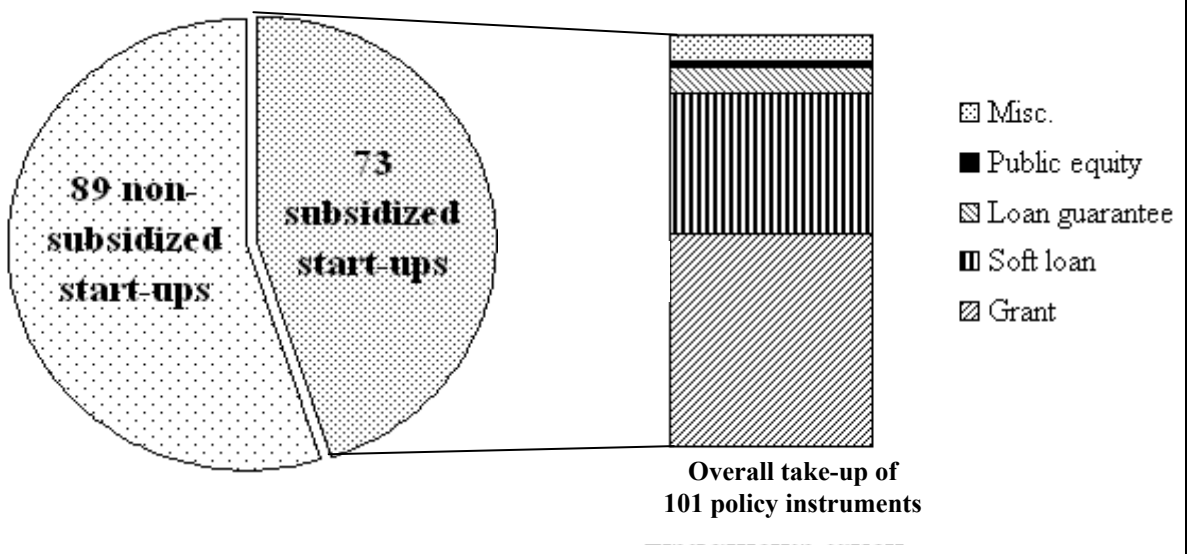
The structured interviews were conducted by the members of the research project. We were supported by student research assistants who were trained in various sessions in December 2007. On average, an interview took one and a half hours. The interviews covered a broad set of questions regarding sociodemographic and psychological data of the founder. Moreover, we inquired into the founder's activities along the founding process. Economic data focused on the time before the first business year and the first three business years. Retrospective data relating to events in the founder's life and to the business history were collected using a modified version of the Life-History Calendar (Belli et al., 2004), which increases the validity of retrospective data.[26]

[26] This method is based on the principles of autobiographic memory. In a first step, we asked interviewees about the timing of well-known events (e.g., marriage). In a second step, these events served as anchors for less well represented events (e.g., first interest in entrepreneurship).

I analyze 162 genuinely new start-ups that were all founded later than 1993[27] and that did not engage in R&D within their first three business years. However, they might be still innovative and growth-oriented since Bhidé (2000) points out that promising start-ups are rather characterized by the personal capacity of their founder or promising market opportunities rather than deep R&D. Financial subsidies were given to 73 of these firms (45.1%) at sometime during the first three business years. The mere receipt of any subsidy within the first three business years is denoted with the dummy variable *Subsidy*. Since start-ups can make use of several policy instruments simultaneously, policy take-up is further specified by five policy instruments: soft loans, loan guarantees, grants, public equity financing, and other support. Soft loans and grants are the most widespread instruments (see Fig. 1). Loan guarantees are only used in combination with soft loans. Therefore, these two instruments are closely related and thus are pooled in the following analysis.

Three observations are dropped from further analysis: the only observation that received public equity funding and two observations that received "other" policy support. All remaining subsidized start-ups receive either soft loans (possibly combined with loan guarantees) and/or grants. Founders were asked which instrument was the most important. These answers are captured by the variable *Subsidy_type*, which distinguishes between "no subsidies", "soft loan/loan guarantee", and "grant": 17.0% of founders received soft loans (potentially combined with loan guarantees) and consider these as the most important policy support. Grants constitute the most important policy support for 27.0% of the start-ups investigated.

[27] This is done to exclude any effects of German Reunification in 1990. Additionally, 88 start-ups were removed because they were not genuinely new (e.g., they were a new branch or new business area of an existing company) or because they suffered from poor interview quality.



Note: N = 162; start-ups can make use of more than one policy instrument

Figure 2.1: Take-up of policy instruments within the first three business years

2.3.2 Targeting of policy support

Does actual policy allocation follow the rationale of positive external effects or do policymakers focus on remedying capital market imperfections? In the following, the targeting of policy support is analyzed with a logistic regression.

Variables

The variables below specify ex-ante characteristics that describe whether policy targeting is oriented toward innovativeness, high-growth entrepreneurship and endowments of human capital, and/or financial resources. Variable definitions and descriptive statistics are given in Table 2.2; Table 2.3 sets out the intercorrelations.

	Variables	Variable description	Mean	Sd
Innovativeness	Novelty	The novelty of the business idea refers to the degree of its newness. Five categories were given: novelty (0), regional or local (1), supra-regional but national (2), European (3), and global novelty (4).	0.62	1.01
High-growth entrepreneur-ship	Growth goals	Interviewees had to classify their goals at the beginning of the first business year given the following contradictory pair with a 5-level scale in-between: to generate constant revenues vs. to generate constantly rising revenues. If founder's growth goals are above the mean, the dummy variable is coded 1.	0.60	0.49
Human capital	University degree	The dummy variable indicates if the interviewed founder had (at least) a university degree at the beginning of the first business year.	0.70	0.46
	Previous self-employment	The dummy variable indicates if the interviewed founder was self-employed at any time before the first steps in the founding process.	0.39	0.49
	Team start-up	Team start-ups are defined as venture set-ups where more than one person was actively involved in the founding process and was intended to become an owner of the company. This dummy variable is coded 0 in the case of a single founder, and 1 in the case of a team start-up.	0.65	0.48
Financial resources	Initial capital	The amount of starting capital at the beginning of the first business year was asked for with the help of the following categories: 1,000 EUR or less (1), more than 1,000 to 10,000 EUR (2), more than 10,000 to 50,000 EUR (3), more than 50,000 to 100,000 EUR (4), more than 100,000 to 250,000 EUR (5), more than 250,000 to 500,000 EUR (6), more than 500,000 EUR (7).	3.14	1.10
Control variables				
Year dummies	Year 1994–1997	Dummy variables that capture the time of business start, i.e., the first business year of the company when accounting started either because of obligations from the commercial register or because of first revenues.	0.44	0.50
	Year 1998–2001		0.36	0.48
	Year 2002–2006		0.19	0.40
Nace industry dummies (NACE, 1 digit)	Nace 2	Chemical industry, metalworking industry, engineering	0.16	0.37
	Nace 3	Electrical engineering, fine mechanics, and optics	0.19	0.40
	Nace 7	Information and communication technology, R&D, services	0.33	0.47
	Nace x	Miscellaneous industries	0.31	0.47
N = 159				

Table 2.2: Variable definition and descriptive statistics

Founders' ambitions have been found to be positively related to subsequent firm growth (Wiklund and Shepherd, 2003), thus justifying *Growth goals* as an ex-ante characteristic of high-growth entrepreneurship. Three variables describe the start-up's endowment with human capital. The variable *University degree* captures general human capital, whereas *Previous self-employment* is regarded as an important indicator for specific human capital (Brüderl et al., 1992). For instance, experienced entrepreneurs have been found to identify more opportunities and exploit more innovative opportunities with greater wealth creation potential (Ucbasaran et al., 2009). A *team start-up* accumulates the human capital of its members; therefore, it is controlled for multiple founders.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Employment growth	-															
(2) Credit rating	-0.15 *	-														
(3) Subsidies	0.19 **	0.04	-													
(4) Novelty	-0.14 *	-0.03	-0.04	-												
(5) Growth goals	0.07	0.10	-0.05	-0.08	-											
(6) University degree	-0.13 *	-0.11	0.06	0.04	-0.09	-										
(7) Previous self-employment	-0.18 **	0.18 **	-0.14 *	0.35 ***	-0.03	-0.04	-									
(8) Team start-up	-0.09	0.12	0.06	-0.06	-0.08	0.01	0.04	-								
(9) Initial capital	-0.04	-0.07	0.23 ***	-0.07	0.14 *	-0.02	-0.12	0.10	-							
(10) Year 1994–1997	0.04	-0.02	-0.12	-0.10	-0.10	-0.02	-0.14 *	0.01	0.12	-						
(11) Year 1998–2001	0.01	-0.00	0.04	0.08	0.20 **	0.10	0.20 **	-0.03	-0.11	-0.67 ***	-					
(12) Year 2002–2006	-0.06	0.03	0.11	0.03	-0.11	-0.09	-0.07	0.02	-0.03	-0.44 ***	-0.37 ***	-				
(13) Nace 2	0.24 ***	-0.11	0.26 ***	0.21 **	0.05	-0.12	-0.04	-0.11	0.15 *	-0.05	0.05	-0.00	-			
(14) Nace 3	-0.04	-0.02	-0.02	-0.01	0.08	-0.13	-0.07	0.09	0.19 **	0.08	-0.08	-0.00	-0.22 ***	-		
(15) Nace 7	-0.07	0.02	0.06	0.01	-0.06	0.20 **	0.02	0.03	-0.13	-0.05	0.03	0.03	-0.31 ***	-0.34 ***	-	
(16) Nace x	-0.09	0.09	-0.25 ***	-0.17 **	-0.05	0.00	0.07	-0.02	-0.15 *	0.03	-0.01	-0.03	-0.30 ***	-0.33 ***	-0.47 ***	-

Note: * p < 0.1; ** p < 0.05; *** p < 0.01
N = 159; however, due to missing values for the credit rating, the intercorrelations with the survival indicator comprise only 125 observations.

Table 2.3: Correlation matrix

Logistic regressions

The following regressions reveal the characteristics which influence subsidization. In a first step, the logistic regression analyzes whether innovativeness, high-growth entrepreneurship, human capital, and/or financial resources indicate subsidization. Therefore, the variables described in Table 2.2 are employed as independent variables. The estimates of the logistic regression are given in the first column of Table 2.4. The novelty of the business idea *(Novelty),* founder's *Growth goals* as well as the human capital variables have no impact on the probability of receiving subsidies. The amount of *Initial capital* exerts a positive and highly significant impact on the probability of receiving subsidies. Having been founded more recently increases the probability of subsidization (significant at the 10% level). Subsidies are more likely to be given to start-ups operating in the chemical industry, metalworking industry, and engineering (*Nace 2*) (r: 1.912; p = 0.002). Furthermore, the coefficient of *Nace 7* (information and communication technology, R&D, services) indicates a positive relationship to subsidization at the 5% significance level.

	Logistic regression	Multinomial logistic regression (base outcome: no subsidization)	
Dependent variable	*Subsidy*	*Subsidy type*	
	Take-up of subsidies yes/no	Soft loans (and loan guarantees)	Grants
Novelty	-0.067	-0.084	-0.098
Growth goals	-0.553	-0.455	-0.650
University degree	0.348	-0.168	0.684
Previous self-employment	-0.557	-1.285**	-0.187
Team start-up	0.370	0.626	0.234
Initial capital	0.569***	0.586**	0.553**
Year 1998–2001	0.757*	0.156	1.160**
Year 2002–2006	0.923*	-0.115	1.507***
Nace 2	1.912***	2.204***	1.714**
Nace 3	0.529	0.435	0.563
Nace 7	0.922**	1.138	0.824
Constant	-3.130***	-3.582***	-4.039***
Number of observations	159	27	43
		159	
Log likelihood	-91.888	-131.934	
Pseudo-R^2	0.1575	0.1529	

Note: * p < 0.1; ** p < 0.05; *** p < 0.01
89 nonsubsidized start-ups form the base outcome in the multinomial logistic regression.

Table 2.4: Logistic regressions

In a second step, a multinomial analysis is conducted to distinguish between the two major policy instruments – soft loans (combined with loan guarantees) and grants. The results of the multinomial logistic regression are shown in Columns 2 and 3 of Table 2.4. A history of previous self-employment reduces the chances of receiving a soft loan/loan

guarantee (r: -1.285; p=0.035), but has no effect on the receipt of a grant. Grants are given significantly more often to start-ups founded more recently (time dummies significant at 1% and 5% levels). Otherwise, the separate analysis of grants and soft loans/loan guarantees in the multinomial logit regression does not reveal different characteristics which influence subsidization compared to the aggregate measure *Subsidies*.[28]

Results

The logistic regressions fail to reveal that subsidy allocation is based on start-ups' ex-ante characteristics as hypothesized in Table 2.1. Hence, the analysis sheds no light on whether policy is focused on remedying capital market imperfections or on the creation of positive external effects. Apart from a positive impact of the amount of financial resources (*Initial capital)* on subsidization, which indicates policy targeting of start-ups likely to yield positive external effects, all other indicators of the rationale for policy targeting are insignificant (*Novelty, Growth goals, University degree*, *Team start-up*). Hence, the allocation achieved by policy schemes does not suggest that the schemes are working to address market failure. Furthermore, the multinomial logistic regression reveals no distinct differences between subsidies in the form of soft loans/loan guarantees and grants, thus raising doubts as to the necessity of different instruments.

However, it is not only policymakers and program officials that play a role in the selection of subsidy beneficiaries; founders and their start-ups might self-select into the programs (Storey, 2000). Figure 2.2 shows the self-reported reasons for non-subsidization. The first two categories, which represent 74.2% of nonsubsidized founders, can be viewed as founder self-selection. Self-selection is thus the primary driver of selective policy support which might be (partly) explained by founders' costs (working time) associated with the application for support schemes.[29] The other categories can be more or less regarded as committee selection. The founders of 7.9% of nonsubsidized ventures reported that is was the too-complicated application procedures that prevented them from applying. This category probably blurs with the fourth category ("not eligible, therefore not applied"), as both are simply different forms of dropping out of the information and

[28] Given the relatively low number of observations in each category of the variable *Subsidy_type* and the descriptive character of the logistic regressions, the multinomial logistic regression was also run with a reduced set of independent variables, resulting in only minor changes of the coefficients.

[29] A policy evaluation of innovation support schemes in Saxony (IWH, 2008) reveals considerable expenditure needed for the application of the *Einzelbetriebliche Innovationsförderung*. About 24% of respondents stated that they spent more than 20 working days for the application, 35% needed between 11 and 20 working days and another 18% dedicated between 6 and 10 working days. Only 14% of interviewed firms needed 5 working days or less. There is no correlation between the expenditure for the application procedure and the subsequent amount of the subsidy.

application process. The applications of 5.6% of nonsubsidized founders were rejected, indicating clear-cut committee selection.

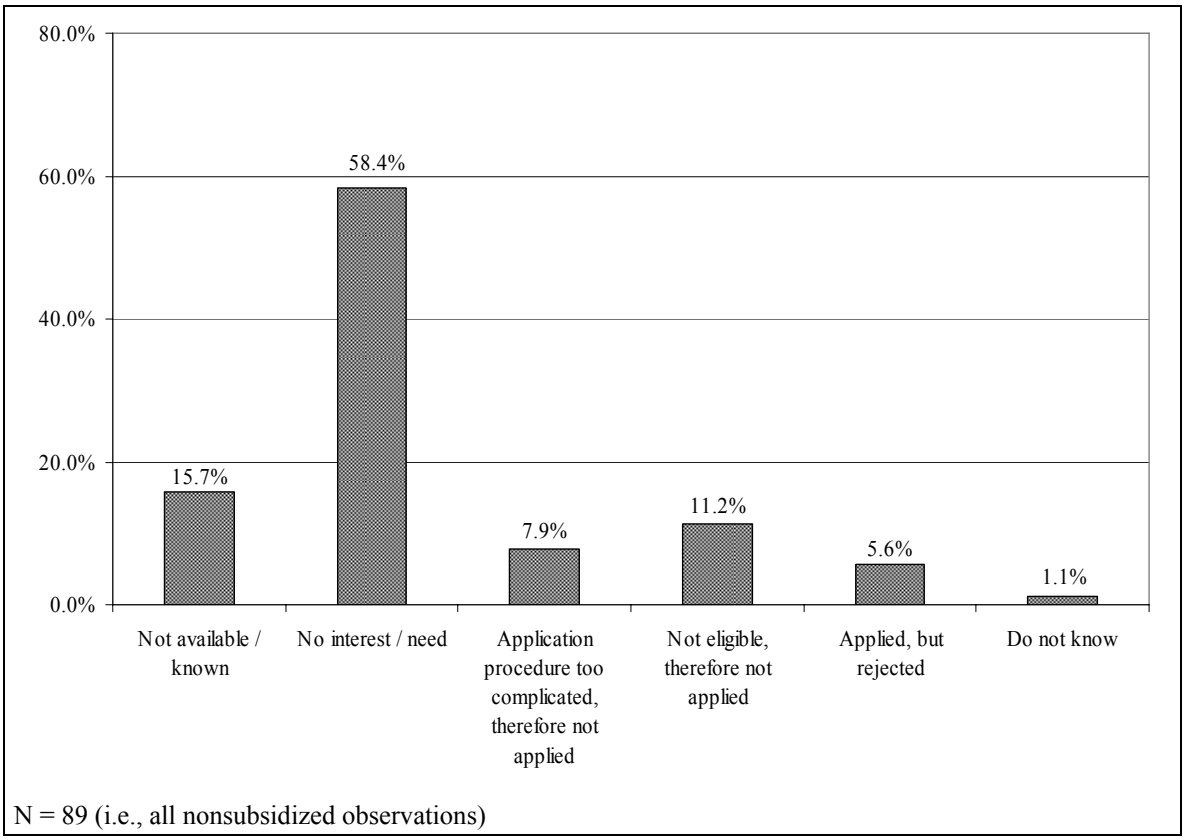


Figure 2.2: Reasons for non-subsidization

Hence, the allocation of start-up subsidies could be driven by both demand and supply and might thus reflect changes in the availability and the design of policy schemes, as well as changing policy take-up over time. For instance, the increased subsidization via grants over time matches the introduction and the increased popularity of start-up subsidies for the unemployed starting in 2002, all of which are grant-based (Caliendo et al., 2008).

To explore the extent of self-selection and program selection I conduct an additional multinomial logistic regression. The dependent variable of the multinomial logistic regression differentiates between three groups of start-ups: those, who are subsidized, those who self-selected not to apply (i.e., who either specified "not available / known" or "no interest / need") and those who were – more or less – put off by program selection (i.e. those who stated a too complicated application procedure, that they were not eligible or had been rejected). The estimates suggest that the selectivity in favor of particular industries can be attributed to program selection exerted by policymakers and program officials. Having less *Initial capital* makes start-ups more likely to absent themselves from subsidy programs (i.e. they self-select out of subsidization). Start-ups founded before 1998 are also more likely to absent themselves from subsidization which

might be explained by the lower availability of subsidies at that time. The regression table and a more detailed description can be found in Appendix A.1.

2.3.3 Effectiveness of policy support

The previous section demonstrates that subsidies are given neither based on the rationale of positive external effects nor on the rationale of capital market imperfections. Therefore, the necessary condition for policy intervention does not appear to be met. Furthermore, a inconsistent allocation of subsidies is argued to be ineffective. Hence, I additionally assess the effectiveness of subsidization with respect to employment growth and survival. First, employment growth is a prominent indicator of firm growth and prosperity; moreover, employment growth is an important policy goal. Second, the long-run survival of a start-up indicates a sustainable policy intervention.

(Outcome) Variables

A start-up's employment growth and survival probability are captured by the following variables:

Employment growth within the first three business years is defined as

$$Employment\ growth = (Employment_{3rd\ year} - Employment_{1st\ year}) \big/ Employment_{1st\ year}\ .$$

Here *Employment* includes work by founders, active partners, conventional employees, hired labor, and trainees. The measure is normalized on full-time positions, thereby considering part-time jobs.

Long-term survival is proxied by the start-up's credit rating five years after founding, which we obtained for each start-up from Creditreform, the leading rating agency in Germany. The variable *Credit rating* thus contains Creditreform's rating index, which ranges from 100 (best) to 600 (worst). Creditreform uses several sources of information in making its ratings, for example, financial and structural risks such as industry, firm size, and productivity, as well as payment history, quantity of orders, firm development, and management quality.[30] The credit rating aims to proxy the start-up's default risk and, indeed, credit rating and survival within the first 5 business years are

[30] For more information on the Creditreform's credit rating system, see Czarnitzki and Kraft (2007).

highly correlated in the present sample (r: -0.462, p = 0.000)[31]. The credit rating thus serves as a continuous variable for the highly skewed dichotomous variable survival.[32]

Matching approach

To identify the causal effect of subsidization, the performance of subsidized and nonsubsidized start-ups cannot be compared directly. Although the findings set out in Section 2.3.2 did not reveal distinct policy targeting, the first two columns of Table A.3 (see Appendix A.4) show differences in previous self-employment, initial capital, and industry between subsidized and nonsubsidized start-ups. These differences, i.e., the selection bias, might lead to different outcomes even in absence of subsidies. Therefore, the counterfactual outcome must be discovered, that is, the outcome of a nonsubsidized start-up if it were subsidized.

Matching procedures based on the potential outcome approach of Roy (1951) and Rubin (1974) have been developed to address the selection bias in observational data. To approach the counterfactual outcome, these authors assume that the selection of firms into subsidization is completely based on observable characteristics. The conditional independence assumption (CIA) states that, given a set of observable exogenous (not affected by the treatment) characteristics, potential outcomes are independent of the treatment assignment (Smith and Todd, 2005). In other words, if one wants to attribute the differential performance to the receipt of subsidies, subsidized and nonsubsidized start-ups should not differ in any other characteristics that impact on the outcome variable. Implicit in this matching approach is the stable unit treatment value assumption (SUTVA), which states that subsidization does not impact on any start-ups other than those that are explicitly treated (Rubin, 1991). In the present context, this implies that subsidies do not impact on nonsubsidized start-ups via market effects or knowledge spillovers. Thus, SUTVA rules out general equilibrium effects of subsidies.

It can be difficult, however, to find a nonsubsidized control unit if there is a great number of characteristics on which matching takes place. To solve this "curse of dimensionality", Rosenbaum and Rubin (1983) propose the use of propensity score matching. The basic idea is not to match on covariates directly, but to match on a function of the covariates that describes the propensity to receive subsidies. This predicted

[31] 9.4% of start-ups of the analyzed sample did not survive the first five years. 8.8% of start-ups in the sample are younger than five years, so nothing can be said about their later survival.

[32] Creditreform does not routinely generate credit ratings for each new start-up, but only if there is an external request from other firms. Because of missing credit ratings, I exclude 34 observations when analyzing the outcome variable *Credit rating*. These nonrated start-ups turn out to have significantly less initial capital than rated start-ups. Hence, it should be borne in mind that the credit rating might imply a systematic bias in favor of the larger start-ups.

probability of group membership is usually obtained from logistic regression. There are various matching algorithms, all of which contrast the outcome of a subsidized start-up with a weighted average of the outcome of (some) nonsubsidized observations. Asymptotically, all matching algorithms should yield the same results (Smith, 2000).

I apply kernel matching, which uses all nonsubsidized start-ups to construct a match for each subsidized start-up. This method is the best choice for my data, since the sample is small and there are almost as many subsidized as nonsubsidized start-ups. Basically, kernel matching juxtaposes the outcome of each subsidized start-up to the weighted sum of all nonsubsidized start-ups. The weights assigned by the weighting function to the nonsubsidized start-ups are higher the closer the nonsubsidized start-ups match the subsidized start-up with respect to the observed characteristics that are captured by the propensity score. The total weight of all controls adds up to 1 for each subsidized start-up. The implementation of kernel matching involves two choices: the choice of a kernel function and the choice of the bandwidth parameter. DiNardo and Tobias (2001) note that the kernel employed is relatively unimportant in practice, but that choice of the bandwidth parameter matters. The bandwidth parameter determines a tradeoff between "few but good matches" (yielding higher variance) and "many but potentially bad matches" (leading to biased estimates). Here, Silverman's (1986) rule of thumb is used to determine the bandwidth parameter and thus to balance bias and variance. The exact matching protocol is set out in Table 2.5. Estimations are made with the psmatch2 Stata ado package by Leuven and Sianesi (2003).

Step 1. A logit model for both outcome variables (employment growth and credit rating) is specified and estimated. In this way, the propensity scores for each observation are obtained. The choice of variables and the estimation of the propensity score are explained in Appendix A.2.

Step 2. The sample is restricted to the region of common support. The common support condition ensures that any set of characteristics of subsidized start-ups (as captured by the propensity score) can also be observed for nonsubsidized ones. The region of common support is determined by a minimum-maximum comparison of the distribution of the propensity score. The imposition of the common support requires dropping 9 (4) observations from the analysis of employment growth (credit rating). The distributions of the propensity score that determine the region of common support can be found in Appendix A.3.

Step 3. The average treatment effect on the treated (ATT) (Table 2.6) is the difference between the mean outcome of subsidized start-ups and matched nonsubsidized start-ups. Following the notation of Caliendo (2006), the average treatment effect for the treated (ATT) can be stated as $ATT = \frac{1}{N_1}\sum_{i \in I_1}[Y_i^1 - \sum_{j \in I_0} W_{N_0}(i,j)\, Y_j^0]$ with Y_i^1 denoting the outcome of the subsidized start-up i and Y_j^0 the outcome of nonsubsidized start-ups j. N_1 (N_0) is the number of observations in the subsidized group I_1 (control group I_0). The outcome of i is thus contrasted with the average weighted outcome of the control group, where the weights are given by $W_{N_0}(i,j) = \frac{G_{ij}}{\sum_{k \in I_0} G_{ik}}$. Thereby, G_{ik} denotes a Gaussian kernel $G[(P_i - P_k)/h]$ with P_i (P_k) standing for the propensity score of subsidized (nonsubsidized) start-ups. The bandwidth parameter h is determined with the following formula, $h = 0.9 \cdot A \cdot n^{-0.2}$ (Silverman, 1986), in which n denotes the number of observations and the term $A = \min(standard\ deviation, \frac{interquartile\ range}{1.34})$ accounts for the distribution of the propensity score.[33]

Step 4. The standard error of the matching estimators is calculated using bootstrapping (200 replications).[34] The estimates for the average treatment effect (ATT) as well as their bootstrapped standard errors and p-values are set out in Table 2.6.

Step 5. The matching quality is assessed by analyzing the mean differences between nonsubsidized and subsidized matched start-ups. After matching, there should be no significant differences regarding any characteristics that are assumed to have an impact on both the receipt of subsidies and the respective outcome variable. A comparison of mean differences between subsidized and nonsubsidized start-ups is given in Appendix A.4.

Step 6. To check the robustness of the results, Steps 3, 4, and 5 are repeated for different bandwidth parameters h, which are employed in the kernel matching algorithm in Step 3.

Table 2.5: Matching protocol

Results

The employment growth of subsidized start-ups exhibits an ATT of 0.3650, i.e., the difference between the mean employment growth of subsidized start-ups (0.9831) and matched nonsubsidized start-ups (0.6180). However, the higher employment growth of subsidized start-ups is not significant. Looking at the indicator for survival, subsidized

[33] The calculation is as follows. For the analysis of employment growth, $A = \min(0.2037, \frac{0.2937}{1.34}) = 0.2037$ is inserted in $h = 0.9 \cdot A \cdot 148^{-1/5}$. Hence, the optimal bandwidth is $h = 0.0675$. Analogous to the previous calculation, the optimal bandwidth for the analysis of our survival indicator is derived by estimating $A = \min(0.1752, \frac{0.2220}{1.34}) = 0.1657$ and $h = 0.9 \cdot A \cdot 121^{-1/5} = 0.0571$.

[34] Although a distribution theory for the cross-sectional and difference-in-difference kernel and local linear matching is derived in Heckman et al. (1998), standard errors for matching estimators are in practice generated using bootstrap resampling methods. The use of bootstrapping is backed by Abadie and Imbens (2008), who suggest that the standard bootstrap can be applied to assess the variability of kernel matching estimators.

start-ups have a mean credit rating of 302.63 compared to the mean rating of 291.45 of their nonsubsidized matched counterparts. Again, the worse credit rating of subsidized start-ups fails to reach significance. Table 2.6 shows that other bandwidth parameters also result in insignificant estimates.[35]

The matching procedure thus does not reveal any impact of subsidies on employment growth or credit rating and thus indicates deadweight losses. Interviewees' self-report of windfall gains is in line with these mixed results. Each founder of a subsidized start-up was asked: "Would you have continued your start-up [or, alternatively, important business projects] without the subsidies?" About one-third (32.9%) answered "yes, readily"; 37.0% said "yes, perhaps or on a reduced scale"; only 26.0% said "no".[36]

	Matching algorithm	Mean outcome of matched		ATT	S.E.	p-value	# Observations	
		subsidized start-ups	non-subsidized start-ups				Sub-sidized	Non-subsi-dized
Employment growth	**Kernel**							
	Optimal bandwidth (0.0675)	0.9544	0.6087	0.3456	0.2809	0.218	64	84
	Bandwidth 0.02	0.9544	0.5751	0.3793	0.2806	0.177	64	84
	Bandwidth 0.04	0.9544	0.6075	0.3469	0.2714	0.201	64	84
	Bandwidth 0.06	0.9544	0.6130	0.3414	0.2686	0.204	64	84
	Bandwidth 0.08	0.9544	0.5991	0.3553	0.2349	0.130	64	84
	Bandwidth 0.10	0.9544	0.5838	0.3706	0.2780	0.183	64	84
Credit rating – Survival	**Kernel**							
	Optimal bandwidth (0.0571)	302.63	291.45	11.18	19.12	0.559	67	54
	Bandwidth 0.02	302.63	306.23	-3.60	29.23	0.902	67	54
	Bandwidth 0.04	302.63	296.55	6.08	21.74	0.780	67	54
	Bandwidth 0.06	302.63	290.86	11.77	19.28	0.542	67	54
	Bandwidth 0.08	302.63	288.25	14.37	18.14	0.428	67	54
	Bandwidth 0.10	302.63	287.23	15.40	20.21	0.446	67	54
Note: No estimate reaches the 0.1 significance level.								

Table 2.6: Overview of results obtained from kernel matching employing various bandwidth parameters

Matching relies on strong untestable assumptions, particularly the conditional independence assumption. The validity of the conditional independence assumption relies crucially on the possibility of comparing subsidized and nonsubsidized start-ups on the basis of pretreatment characteristics. Given the rich dataset, which includes personal data for the founder and the founding team as well as characteristics of the start-up and the business idea, it is plausible to assume that the outcomes and the allocation of subsidies are independent, conditional on observed attributes. Heckman et al. (1997) point out that matching methods substantially reduce biases when, first, all information is collected with

[35] The use of other matching algorithms, such as radius matching, does not yield significant results either. These results are not shown here, but can be obtained from the author.
[36] Due to three refusals, the percentages do not add up to 100.

the same questionnaire for both the subsidized and nonsubsidized start-ups and, second, these are drawn from the same random sample (which is supported by the experimental evidence of Michalopoulos et al. (2004)). Both requisites are met by my dataset. Moreover, the sample is considerably homogenous, since I only consider genuinely new start-ups in innovative industries in the East German state of Thuringia that were not engaged in R&D.

2.4 Discussion and conclusions

In general the results of this chapter indicate policy failure. The logistic regressions suggest that alleged market failure is not targeted and, furthermore, the matching analysis shows no impact of subsidization in terms of higher employment growth or higher chances of firm survival. Ineffective subsidies do not imply that subsidies have no effects at all, however, since subsidies might provide inefficient start-ups with an artificial competitive edge and thus distort market selection. However, I can only speculate about substitution effects because the matching approach explicitly ignores the market effects of subsidies.[37] The present study has several limitations. To begin with, the likelihood and the extent of substitution effects depend on the amount of subsidies, information I do not have. This also implies that I cannot analyze a potential targeting that bases the amount of subsidy on start-up characteristics. Furthermore, small sample sizes and high standard errors provide good reasons to interpret the present results with some caution.

Still, the analysis has significant implications for future evaluations. Although I cannot distinguish between individual programs and funding agencies, my study does point out the limited potential of policy targeting. Since no distinct differences between grant-based intervention and loan-based intervention are found, it is worth asking whether the myriad programs and the diverse structure of funding agencies mitigate intricate information problems in allocating subsidies. If the wide range of different schemes and funding agencies do not, in practice, improve policy targeting, they very well may be quite successful at increasing administrative costs and enhancing the difficulty of policy evaluation, the latter problem arising because each program serves so few beneficiaries that analysis of effectiveness is hampered by low sample sizes (a problem this study ran up against itself).

Moreover, the present findings question fundamentally the general subsidization of start-ups as an instrument to tackle market failure. First, the existence of market failure is far from clear and cannot be claimed to universally hamper entrepreneurship. This is true both for positive external effects (Auerswald, 2007) and capital market imperfections

[37] This is due to the stable unit treatment value assumption (SUTVA).

(Parker, 2002). Moreover, some authors state excessive participation in entrepreneurship resulting from overlending and overoptimism and thus argue for discouraging entrepreneurship (de Meza, 2002; Parker, 2007; Shane, 2009). Even though subsidies do not seem to be an appropriate instrument to tackle market failure, they might be still justified by social policy objectives. Start-up subsidies for the unemployed have been positively evaluated recently. Caliendo et al. (2008) show that minimum 20 months after the phase-out of the assistance between 50-67% of (former unemployed) recipients are still self-employed. Recipients of start-up subsidies are also more likely to be employed and generate higher earnings. However, these partial analyses cannot tell about overall market distortions arising due to subsidies which do not target incidences of market failure.

Second, if policy intervention is agreed upon, incidences of market failure have to be identified individually ex-ante to guide subsidy allocation. Precise policy targeting, however, is unlikely due to fundamental information problems (Holtz-Eakin, 2000). Presumably, banks use the best screening technology available to minimize information asymmetries that cause capital market imperfections, and Parker and van Praag (2006) doubt that government can do a better or even equal job at this, an ability that would be necessary for successful policy intervention. Similarly, Stiglitz and Wallsten (2000, p. 47) describe the "monumental task" of identifying marginal projects that have the potential to yield social returns but that will not be realized in the absence of subsidies because the private returns are too low. Moreover, the extent of self-selection into subsidization (remember that 58.4% of founders indicated no interest and/or need for policy support) limits policymakers' potential of selective policy targeting.

Third, public-choice considerations suggest that policymakers and funding authorities may have incentives that actually conflict with a policy targeting market failure. On the one hand, policymakers and funding authorities are keen on portraying themselves as the engineers of success and are thus motivated to fund projects that would have succeeded even without their help (Lerner, 1999). This situation is further aggravated by a different culture of risk-taking in the public sector. Stiglitz and Wallsten (2000) point out that program officials may have a tendency to focus on choosing projects that have a high probability of success instead of funding projects for which even higher returns can be expected but that are riskier. On the other hand, start-up subsidies also serve as a labor market instrument and thus are given to the potentially less promising ventures (Caliendo et al., 2008; Santarelli and Vivarelli, 2007). Additionally, the myriad of funding schemes results in numerous program officials who have to justify their existence. Rather than doing nothing, they are thus induced to subsidize any start-ups – regardless of whether the

rationale of policy intervention does apply or not. The low rejection rate (remember that only 5.6% of nonsubsidized founders were rejected) supports this view.

The difficulties in identifying incidences of market failure as well as the interplay of policymakers, program officials, and potential awardees blur the actual targeting of policies. However, inconsistent policy allocation has severe implications for policy effectiveness and market distortions. On the one hand, if market failure does not exist, recipients probably do not need subsidization and taxpayers' money spent on such is wasted (Stam et al., 2009). Conversely, a previous evaluation of R&D subsidies finds a distinct policy focus on innovative start-ups and academic spin-offs as well as a high effectiveness of R&D subsidies regarding patent output and employment growth (see Cantner and Kösters (2009a, b) or Chapter 4 and 5, respectively). The findings for the present subset of non-R&D start-ups put the highly positive effects of subsidies earmarked for R&D into perspective and show how important the analysis of subsets of heterogeneous start-ups is. On the other hand, market distortions arise if subsidies cannot be limited to selectively remedy market failure. Therefore, some authors suggest a policy strategy of "picking the winner" because then subsidies are least likely to interfere with market selection (Santarelli and Vivarelli, 2007; Shane, 2009). Yet, those start-ups that exhibit the most promising characteristics are probably the ones that need government support the least.

The information needs for policymaking can be alleviated by choice of policy instrument. Human-capital-based policy instruments are favored by most economists (e.g., Fritsch, 2008; Audretsch and Thurik, 2001), since start-ups with high endowments of human capital are less likely to face capital constraints and, at the same time, are more likely to yield social returns. Moreover, Schmitt-Rodermund and Vondracek (2002) emphasize that career interests are formed early in adolescence. They thus suggest policy action that helps adolescents discover their interests and abilities and makes them aware of entrepreneurship as a career option. This kind of entrepreneurship education should be offered to all adolescents, i.e., all potential future entrepreneurs. Thereafter, special training should be provided for those who have the right combination of personality and entrepreneurial orientation. In this way, the targeting problem is more clear-cut and, additionally, such a policy initiative will not distort market selection, since it targets the individual before the actual start-up of the venture. However, such a policy focus would require a major shift in actual policymaking – away from targeting start-ups and established firms and toward empowering the individual (potential) entrepreneur.

3. Building winners? Perceived usefulness and economic effects of public business assistance in the founding process[38]

3.1 Introduction

Publicly financed programs offering advice and training to nascent entrepreneurs are popular policy instruments across the globe (Bosma et al., 2008). Support, in the form of specialized training and provision of information, advice, and various kinds of practical assistance, aims to assist "entrepreneurs to successfully develop their business activity and to respond effectively to the challenges of their business, social and physical environment" (European Commission, 2001, p. 7; Lundström and Stevenson, 2005). In short, the nearly universally employed human-capital-based approach to business assistance is designed to "build winners" rather than choose them. For example, between 2007 and 2013, the European Social Fund will spend € 45,000,000 on advice and coaching to support entrepreneurship in the federal German state of Thuringia alone (ESF, 2009). In fact, it is the business assistance provided to start-ups by this German state that will be the empirical base of the present article. Given various other additional funding sources, the volume of public expenditure calls for rigorous evaluation of these assistance programs (European Commission, 2001).

Business assistance schemes can be assessed along two dimensions. First, from an economic perspective, publicly financed business assistance targeted at nascent entrepreneurs is justified by the *positive external effects* accruing from entrepreneurship (Audretsch et al., 2007; Storey, 2003).[39] Social benefits arise when start-ups introduce innovation, increase variety, and spur competition, thus leading to increased productivity and economic growth (Fritsch, 2008). However, many (potential) entrepreneurs lack the managerial and technical skills necessary for developing an organization (Shane, 2004, p. 241; Chrisman et al., 2005). Since entrepreneurial competence can be acquired – at least partly – through training and mentoring (Markman and Baron, 2003; Chrisman et al., 2005), one goal of publicly financed business assistance is to teach nascent entrepreneurs how to successfully launch a competitive and innovative venture. Therefore, the success of

[38] This chapter is based on joint work with Martin Obschonka.

[39] Additionally, a lack of recognition and asymmetric information are put forward as a rationale for publicly financed business assistance schemes (Storey, 2003). Founders ignore the private benefits of external advice and are thus usually averse to paying fees for any advice or training from outsiders. However, the argument of asymmetric information justifies only a one-off "taster" subsidy, and not general public provision of advisory services (Storey, 2003). Moreover, business assistance schemes sometimes are implemented for sociopolitical reasons and thus aim to promote the economic status of disadvantaged groups (Reynolds, 2007).

such policy must be judged on the basis of the positive external effects created by the assistance.

Second, in addition to external effects, understanding how business assistance operates is a central aim of public-policy-related entrepreneurship research (Chrisman et al., 2005). Generally, business assistance is targeted at the individual nascent entrepreneur, who, in turn, should be able to transform this assistance into a tangible, or at least measurable, economic outcome (Chrisman et al., 2005). Understanding *why* one nascent entrepreneur perceives business assistance as efficacious, whereas another does not, could provide new information on the person-specific impact of business assistance.

Studying both objective (economic) and subjective (personal) performance measures in entrepreneurial evaluation research is not a new idea (Storey, 2000), but a close look at the extant literature shows up several shortcomings of this work. First, previous studies employing subjective assessments of business assistance have been mainly restricted to monitoring policy delivery (Storey, 2000). Second, prior research focuses mainly on the assessment of one particular scheme (e.g., Chrisman et al., 2005; Chrisman and McMullan, 2000; Chrisman, 1999; Wren and Storey, 2002), which limits the generalizability of the results given the diverse range of real-world business support schemes. This is particularly true for Germany, where a broad selection of such schemes – administered by various providers and funded by various institutions – offer a wide and diverse range of support (Bundesministerium für Wirtschaft und Technologie, 2008). Hence, evidence as to the actual use of business assistance is needed to discover the unit of investigation, i.e., the effects of a particular kind of business assistance. Finally, most evaluations fail to account sufficiently for selection bias (Storey, 2003).

In view of these limitations of previous research, the aims of our study are the following. First, this study will explore patterns of actual policy take-up. Our representative sample of Thuringian start-ups allows us to take an aggregate view of business assistance schemes and characterize the scope and intensity of assistance along the founding process. Second, we analyze the predictors of policy take-up and perceived usefulness of business assistance and thus seek to provide insights into both policy targeting and the person-related effects on the assisted entrepreneurs. Finally, this study aims to assess the economic impact of business assistance on subsequent business performance employing propensity score matching, which allows us to correct for selection bias.

We find distinct patterns in the use of business assistance, which emphasizes the importance and necessity of our investigation into this topic. Our results suggest that a lack of entrepreneurial resources (as indicated by a lack of human and social capital and a less

distinct entrepreneurial personality make-up) makes people select into comprehensive business assistance and perceive such assistance as more useful. However, propensity score matching cannot reveal that the use of business assistance results in better start-up performance in terms of amount of initial capital, long-run employment, and credit rating. The findings further emphasize the need for interdisciplinary evaluations: even though business assistance does not seem to have an impact on a start-up's long-run performance, it still might be useful to individual founders who lack personal entrepreneurial resources (such as entrepreneurial human and social capital or an entrepreneurial personality) in actually starting a business.

The chapter is structured as follows. Section 3.2 reviews the range of business assistance schemes and previous evaluation studies. In Section 3.3, we set out our evaluation approach, which is designed to overcome the shortcomings of previous work. Empirical analyses are conducted in Section 3.4. Section 3.5 concludes the chapter with a discussion of our results.

3.2 Public business assistance in the founding process

3.2.1 Range of business assistance schemes

Nearly every developed country provides subsidized business support to nascent and young entrepreneurs, as well as to small and medium-sized enterprises (Bosma et al., 2008). Large-scale initiatives of this type include the Small Business Development Center program in the United States (SBDC), the ALMI in Sweden (Hjalmarsson and Johansson, 2003; Storey, 2003), and the Business Links framework in the United Kingdom (Mole et al., 2008). Advisory services targeted at small and medium enterprises (SMEs) have been in existence since the 1980s (Storey, 2003), but it is only more recently that there has been a reorientation of these types of programs toward nascent and start-up entrepreneurs (Lundström and Stevenson, 2005). Lundström and Stevenson (2005) find, moreover, not only a trend toward supporting the early phases of the entrepreneurial process, but also that business support schemes are increasingly targeted at very specific segments of entrepreneurship, for example, technology-oriented nascent entrepreneurs, women or minorities.

This segmentation is accompanied by a great variety of public assistance services, which are mainly provided by (subsidized) private-sector consultants, colleges, and universities, as well as by chambers and industry associations (Storey, 2004; TMWTA,

2009).[40] Innovative technology-oriented or knowledge-based projects are one of the targets of policy initiatives; this is true for the East German state of Thuringia, which is the empirical base for our analysis. For example, a network of universities, business incubators, and the Chambers of Industry and Commerce (*Get-up / Thüringer Gründer Netzwerk*), established in 1998, concentrates its business assistance on founders of technology-oriented and knowledge-based start-ups (TMWAI, 2003). This implies that each Thuringian university has a contact point for potential and nascent academic entrepreneurs. Coaching is also an integral part of *EXIST Seed*, a (financial) support program for academic spin-offs (Kulicke and Schleinkofer, 2008). Moreover, start-up assistance to the unemployed often includes consulting services. Since the Federal Employment Office gives start-up grants only to founders with a sound business plan, applicants can be required to make use of (subsidized) external consulting services (Bundesagentur für Arbeit, 2009).

The subsidy environment is confusing due to not only the great variety of public support schemes, but also to the various types of business assistance offered. Generally, business assistance can be categorized as either operational or strategic support (Hjalmarsson and Johansson, 2003; Barney et al., 1996; Chrisman and Leslie, 1989). Operational services are objective and encompass known knowledge among experts; strategic advice is more individually oriented and is developed interactively between consultants and clients (Hjalmarsson and Johansson, 2003). Then, information previously unthought-of emerges whose communicability is limited. Strategic assistance can be thus expected to be more time-intensive (Chrisman and Leslie, 1989). Although most advisory services are designed for particular groups, the scope and intensity of assistance actually provided can be expected to be strongly determined by self-selection of founders. In particular, Hjalmarsson and Johansson (2003) argue that strategic services are developed in a symmetric relation between clients and consultants. The use of strategic services implies a strong commitment on the part of the founder, considering that a certain amount of effort (and time) will be needed to choose the appropriate advisor and convey enough information to make the service selected worthwhile.

[40] The wide range of initiatives with diverse funding institutions has led to a shift in policy. Beginning in 2007, the federal level is solely responsible for business assistance to start-ups that are younger than five business years. Business assistance targeted at nascent entrepreneurs is now the responsibility of the *Länder* authorities (Bundesregierung, 2008). However, this new structure of funding business assistance schemes is not the subject of this chapter.

3.2.2 Previous evaluation studies

To date, evidence as to the effectiveness of assistance schemes has been ambiguous, leading Davidsson (2002) to conclude that many programs do not work. Various previous evaluation studies are summarized in Table 3.1, which also sets out several explanations for the equivocal results.[41] First, previous analyses of business assistance schemes differ in their evaluation designs. In his examination of evaluation designs, Storey (2003) raises the criticism that policy initiatives in OECD countries are mainly monitored and thus lack rigorous evaluation. Therefore, Table 3.1 organizes evaluation studies by rigor of their analysis, with (a) experimental evidence ranking higher than (b) multivariate econometric studies that control for factors that affect the effectiveness of business assistance. This is not possible when conducting (c) mean comparisons or (d) monitoring business assistance merely by describing policy take-up. These methodological differences hamper the comparability across studies. Furthermore, less rigorous analyses cannot detect causal relationships. In particular, studies rarely control for self-selection (Storey, 2000, 2003), even though self-selection into consulting is highly plausible (Chrisman and McMullan, 2000). Without controlling for self-selection of founders with promising (less promising) ventures into assistance schemes, evaluations will overestimate (underestimate) their impact.

Second, the analyzed assistance is very diverse in intensity and scope, covering everything from intense strategically-oriented counseling to one-time operational advice. In addition, the various providers of business assistance, which also encompass a wide range, from university-based initiatives and venture capitalists to the Chambers of Industry and Commerce, do not only target nascent entrepreneurs but also young entrepreneurs and owner-managers of small enterprises. Moreover, with the exception of Parker and Belghitar (2006), previous studies focus on evaluating individual schemes, an approach hardly reflective of the "real" world, where a great many programs exist simultaneously and founders take up a mix of different schemes offering assistance in several subject matters. Third, the impact of assistance schemes in prior work is usually measured by various outcome variables ranging from subjective measures of recipients' satisfaction to objective measures of subsequent business performance such as sales, employment, or survival (McMullan et al., 2001). The use of different outcome measures can be partly attributed to policymakers, who usually do not specify measurable objectives of assistance schemes (Storey, 2003). Finally, institutional setting could be important, thus hampering the

[41] Table 1 is based on a tabulation of studies on small business assistance programs in the United States done by Gu et al. (2008). For a more comprehensive overview of evaluations of U.S. schemes, the reader is directed to the original work.

generalizability of findings from policy evaluations conducted in Europe, Latin America, and the United States.

Study	Analyzed scheme/unit of analysis	Data	Control for selection bias	Treatment variable	Performance measure/outcome	Covariates/controls	Findings
a) Experimental study							
Karlan and Valdivia (2006)	FINCA Peru – a "village banking" organization for poor, female microentrepreneurs in Lima and Ayacucho	Baseline survey few weeks prior to the training in 2002 and 2003; follow-up surveys 2 years later; N=4,591	Not needed, random assignment	- Random assignment into either mandatory or voluntary assistance or no treatment at all - Assistance included general business skills and strategy training, not client-specific problem-solving - Weekly to bi-weekly training	- Institutional outcomes (e.g., repayment rates of micro credits) - Business skills and practices - Business outcomes - Household outcomes, including empowerment in decision making and child labor	Subgroup analyses differentiating between - Location - Type of treatment (mandatory vs. voluntary) - Ex-ante attitude toward training - Education - Civil status - Business size	Both clients and microfinance institutions profit from concomitant business assistance: the microfinance institution benefits from increased retention and repayment, and the clients showed greater business knowledge and better business outcomes. Interestingly, the effect was strongest for those clients who expressed the least interest in the training at the very beginning.
b) Econometric analyses							
Barney et al. (1996)	Venture capital assistance to start-ups	Start-ups that received venture capital and that were identified in the *Venture Capital Journal*; mainly high-tech firms; N=205	No	- Business management advice (strategic) - Operational assistance	Venture teams' perceived usefulness	- Industry experience - Team tenure - Innovativeness - Engagement of venture capitalists - Year of first-round funding	Business management advice and operational assistance is assessed worse the more industry experience the new venture team has. Business management advice is more welcome when start-up teams' primary experience is from another industry. Current firm performance is not related to new venture teams' evaluation of VC assistance.
Chrisman et al. (2005)	Small Business Development Center (SBDC)–U.S. program offering counseling assistance to nascent entrepreneurs	Survey conducted in 2001; receipt of SBDC counseling was 5–9 years prior thereto, N=159	No	Varying degrees of time spent in direct contact with SBDC counselor within nascent phase	- Employment - Sales	- Founder's prior experience - Founder's education - Scope of target market - Firm age - Industry	Positive relationship between time spent in guided preparation and sales and employment 3 to 8 years after start-up.
Mole et al. (2008)	Business Link network (BL)–English network offering publicly supported advisory services to small and medium-sized enterprises	Telephone survey of 2,000 firms, around half of which had received intensive assistance from BL between April and October 2003	No	Intensive assistance by BL	- Employment growth - Sales growth	- Firm size - Firm age - Legal form - Market characteristics - Business strategy - Age of owner-manager - Previous self-employment	Intensive assistance from the Business Link network seems to have a positive effect on simultaneous employment growth (no significant effect on sales growth).

Study	Analyzed scheme/unit of analysis	Data	Control for selection bias	Treatment variable	Performance measure/outcome	Covariates/controls	Findings
Parker and Belghitar (2006)	Random sample of nascent entrepreneurs in the U.S.; different schemes of business assistance – either government sponsored or funded by universities/business associations	Panel Study on Entrepreneurial Dynamics (PSED); interviews in 1998/1999; follow-up interviews 12 months afterward; N=340	Control for ignorance about business assistance programs	- Dummy variable for general participation in business assistance schemes - Separate dummy variables for either government-sponsored programs or programs funded by university/business associations	Status of founding process: being still nascent entrepreneur vs. having started venture vs. having quit	- Durable good - High-tech start-ups - Marital status - Gender - Being homemaker - Industry	Participation in business assistance programs does not appear to significantly affect outcomes even when controlling for awareness of programs. However, separate analysis of different providers of assistance reveals impact of business assistance on turning nascent entrepreneurs into actual entrepreneurs (significant at 10% level).
Stubner et al. (2007)	Venture capital assistance to German start-ups	German start-ups that received venture capital in 2002; N=106	No	Management support by venture capitalists	- Absolute EBITDA (earnings before interest, taxes, depreciation, and amortization) - Earnings growth - Subjective assessment of goal achievement - Subjective attribution of management support on firm performance	- Subjective evaluation of quality of management support - Characteristics of founder team - Company age - Company size	Quality of management support is positively related to EBITDA and the subjective performance measures.
Wren and Storey (2002)	Marketing Initiative within the U.K. Enterprise Initiative that aimed to provide SMEs with a marketing strategy; the program ran from 1988 to 1994	All eligible small and medium-sized enterprises in the West and East Midland of England, the South West of England, and South Wales; survey in 1996; N=4,326	Yes: two-step adjustment procedure for addressing selection bias	Completion of consultancy	- Sales turnover - Employment - Survival of SMEs	- Prior turnover - Prior employment - Independency of firm - Export orientation - Industry - Region	Counseling impacts on sales turnover, employment, and survival. However, the program is most effective for medium-sized companies. No impact on survival measure could be found for smaller firms as a group.
c) Mean comparisons							
Chrisman and Leslie (1989)	Small Business Development Center (SBDC) – U.S. program offering counseling assistance to small businesses	Small business clients from SBDC in 1985/1986; N=76	No	Receipt of 12 or more hours of SBDC counseling in strategic, administrative, or operating issues; comprehensiveness of assistance	- Sales growth - Subjective assessment of financial performance	Control for potential moderating effect of the clients' type of business	In the short run, small business clients benefit more from administrative and operating assistance, suggesting a short-run impact on reducing costs.

Study	Analyzed scheme/unit of analysis	Data	Control for selection bias	Treatment variable	Performance measure/outcome	Covariates/controls	Findings
Chrisman (1999)	Small Business Development Center (SBDC) – U.S. program offering counseling assistance to nascent entrepreneurs	Clients from SBDC in 1992; mail questionnaire in 1994; N=2,025	No	Receipt of five or more hours of SBDC counseling	Start-up of venture one year after SBDC assistance measured by either - having become an organization, - having hired employees, or - having made sales	Analysis of subsamples in order to identify regional effects	Nascent entrepreneurs who take up SBDC program are more likely to actually start the business.
Chrisman and McMullan (2000)	Small Business Development Center (SBDC) – U.S. program offering counseling assistance to nascent entrepreneurs	Clients from SBDC in 1992 and 1994; follow-up surveys one year later; those founders were contacted in 1997 who responded to first follow-up survey and who had indicated that they had successfully started a firm; N=169	No	Receipt of five or more hours of SBDC counseling	- Survival - Employment growth - Sales growth - Innovativeness - Perceived usefulness	Not applicable	Start-ups that took up the SBDC program show higher rates of survival, growth, and innovation than what an average population of ventures would suggest. In retrospect, the vast majority perceives the counseling as beneficial.
d) Monitoring							
Chrisman (1989)	Small Business Development Center (SBDC) – U.S. program offering counseling assistance to nascent entrepreneurs	Clients from SBDC in 1985 and 1986; survey in 1987; 36.8% of respondents did not start business; N=123	No	Receipt of 12 or more hours of SBDC counseling in strategic, administrative, or operating issues	Clients' perception of the value of SBDC assistance	Analysis of subsamples in order to determine if the relationship between the perceived value and the kind of assistance was moderated by the consultant, the client, and the venture	Strategic assistance (but neither operating nor administrative assistance) is positively associated with the perceived value of its service.
Kulicke (2004)	Business assistance provided within EXIST, a federal German program that aims to boost academic spin-offs	Founders from EXIST-funded start-ups; telephone survey in 2002/2003; N = 196	No	Analysis of scope and intensity of actual business assistance	Perceived usefulness of business assistance	Not applicable	52.9% of respondents made use of some kind of business assistance in the firm formation process. Three different patterns of policy take-up can be observed, with assistance differing in scope and intensity. Overall perceived usefulness of business assistance is high (51% of respondents perceive its usefulness as high; only 16% indicate a low usefulness).

Table 3.1: Previous evaluation studies of (partly publicly financed) business assistance given to (nascent) entrepreneurs as well as owner-managers of SMEs

3.3 Evaluation approach

Our evaluation is designed to overcome the shortcomings of previous research by, first, exploring patterns of actual policy take-up (Section 3.3.1), second, investigating predictors of take-up and perceived usefulness (Section 3.3.2) and, third, examining the assistance's impact on subsequent business performance (Section 3.3.3).

3.3.1 Exploring actual policy take-up

As shown in Table 3.1, previous evaluation studies assess the impact of one particular policy scheme and often model the treatment as a binary variable. Given the wide range of support services described in Section 3.2.1, actual take-up of policy schemes is determined by both self-selection and program selection. Program selection effects occur due to specialized programs designed for, e.g., academic entrepreneurs or the unemployed (Lundström and Stevenson, 2005). However, since most German business support schemes are open to all comers (Bundesministerium für Wirtschaft und Technologie, 2008), program selection effects are assumed to be relatively weak. More importantly, nascent entrepreneurs self-select into business assistance schemes and make decisions about the scope and intensity of services they use (Chrisman and McMullan, 2000; Kulicke, 2004). This self-selection leads to the observation that there are different patterns of policy take-up even within single assistance schemes. Examining business assistance offered by *EXIST*-funded networks in Germany,[42] Kulicke (2004) finds three different types of actual take-up of business assistance: some founders require quick and rather general advice, a second group needs support in a particular subject matter, and the third type takes advantage of intensive support throughout the entire founding process. In summary, then, an exploration of actual policy take-up is necessary to discover the unit of evaluation. If there are distinct variations in the use of business assistance across founders, we are interested in whether these differences in scope and intensity of business assistance also cause different effects.

3.3.2 Take-up and perceived usefulness of business assistance

Having explored the actual unit of investigation, we are interested in the determinants of individual policy take-up and founder's perceived usefulness of business assistance. This information will provide deeper insights into the effects of business assistance (McMullan

[42] The federal *EXIST* program started in 1998 and aims to boost academic spin-offs as well as to create a regional entrepreneurial climate (Audretsch and Beckmann, 2007).

et al., 2001) since it is comprised of the personal judgment of the most central actor in both the business assistance process and the firm formation process, that is, the entrepreneur. In the following, we argue that a founder's personal entrepreneurial resources as well as characteristics of the start-up project are crucial in explaining both patterns of take-up of particular business assistance and the perceived usefulness of same.[43]

Personal entrepreneurial resources

It is expected that differences in business assistance take-up, as well as in perceived usefulness, are a function of founders' personal entrepreneurial resources. Those nascent founders who *lack* the necessary resources needed for entrepreneurship should thus select themselves into (specific) business assistance and should perceive this as more useful. This situation can be described as the *"weakness hypothesis"* and is based on Markman and Baron's (2003) person-entrepreneurship-fit framework and psychological control theory (e.g., Heckhausen and Schulz, 1995).

Markman and Baron (2003) argue that entrepreneurs who lack important resources (e.g., human and social capital, entrepreneurial skills and ability, self-efficacy) have a poor person-entrepreneurship fit and are thus more likely to be unsuccessful in their entrepreneurial activity.[44] In our case, nascent entrepreneurs with low resources might not only exhibit a poor fit, but might also *perceive* their weakness, motivating them to seek help and value this help. It seems plausible to assume that the combination of demanding, complex, and stressful entrepreneurial tasks (Schindehutte et al., 2006) and low personal entrepreneurial resources might lead to excessive demand and a sense of loss of control among these founders. According to control theory, however, individuals seek to exert control over their environment (e.g., Heckhausen and Schulz, 1995), and thus we posit that "weak founders" might expend a certain amount of effort to restore their sense of control, for example, by taking up business assistance.[45]

[43] Perceived usefulness is a central evaluation outcome in past evaluation research (McMullan et al., 2001; Storey, 2000).

[44] Such a person-entrepreneurship-fit idea corresponds nicely with fit models in the field of general vocational behavior and development. Here, the fit framework is a leading perspective in contemporary research on individuals' vocational choices, behavior, and success (Fouad, 2006). As an illustration, maybe the most frequently applied and researched fit approach is Holland's (1997) fit theory of vocational choices where he states that individuals with a poor person-job fit will be less successful and less satisfied with their particular job than individuals with a good person-job fit.

[45] Such a challenge-response perspective on human cognition and behavior figures prominently in psychology and sociology (e.g., in coping theories such as the transactional stress theory (Lazarus and Folkman, 1984) or Elder's concept of control cycles (Elder and Caspi, 1990)) and it has been applied to various fields of human behavior in critical transitions or context-situations such as rapid social change (Pinquart and Silbereisen, 2004) or critical life transitions (Heckhausen et al., 2001).

Specifically, we argue that those founders who lack human and social capital as well as entrepreneurial personality traits will utilize business assistance more often than other founders and perceive the same to be more useful. First, a high level of *human capital* has been shown to be related to firm survival and growth (Brüderl et al., 1992) and thus can be viewed as an entrepreneurial resource (Markman and Baron, 2003). Brüderl et al. (1992) argue that knowledge gained in prior self-employment indicates entrepreneur-specific human capital as it might be the best preparation for the entrepreneurial role. Entrepreneurial experience (i.e., previous self-employment) might thus enable entrepreneurs to draw upon routines that have worked well in the past and thus lower their need for external business assistance (see Cooper et al., 1995).[46] Furthermore, novice entrepreneurs might benefit most from business assistance since the acquisition of entrepreneurial and managerial skills might compensate for a lack of experience (Ucbasaran et al., 2009). *Parental self-employment* can be considered as another measure of entrepreneur-specific human capital (Brüderl et al., 1992) as self-employed parents have been shown to serve as both role models and resource providers (Parker and Belghitar, 2006; Davidsson and Honig, 2003).

According to Markman and Baron (2003), *social capital* is an entrepreneurial resource since it proxies other resources that can be made available through social networks and contacts. For example, higher entrepreneurial performance might be achieved through better access to entrepreneurial finance, and since social ties provide a mechanism by which investors obtain information, social ties may facilitate venture capital funding (Shane and Cable, 2002). Consequently, a person's social capital is positively associated with both discovery of entrepreneurial opportunities and the ability to actually take advantage of them (Davidsson and Honig, 2003; Jack and Anderson, 2002). Since nascent entrepreneurs with a rich endowment of social capital have been shown to access resources through their personal network, endowments of social capital might lower the need for public business assistance.

Finally, *personality traits* should also predict take-up and perceived usefulness as past research makes clear that entrepreneurial activity and success are related to an individual's personality (see Rauch and Frese (2007) for a recent meta-analysis). In other words, an entrepreneurial personality is itself an entrepreneurial resource. This should hold true for both specific traits (e.g., need for achievement, self-efficacy, and risk-taking) and broad traits (e.g., the Big Five; Costa and McCrae, 1992). Although broad traits reflect only

[46] However, Cooper et al. (1995) find that the greater search activity of novice entrepreneurs includes only personal sources, not professional sources.

a person's very basic personality, they have been shown to be relevant predictors within the study of entrepreneurship (Rauch and Frese, 2007; Zhao and Seibert, 2006). Schmitt-Rodermund (2004, 2007) could show that a specific Big Five pattern relates to entrepreneurship (individual entrepreneurial characteristics, activity, and success). Analyzing the Terman study[47] data set she shows that adolescents whose Big Five profile was characterized as *high* in extraversion, conscientiousness, and openness and low in agreeableness and neuroticism showed higher levels of early entrepreneurial competence and were more likely to engage in entrepreneurial activity (Schmitt-Rodermund, 2007). Such an operationalization of personality is based on the so-called person-oriented approach (Magnusson, 1998), which has received widespread attention in psychology, but has to date been neglected by entrepreneurship researchers. A person's entrepreneurial personality may not be adequately characterized by single traits alone, but by their configuration. Applying Schmitt-Rodermund's definition of an entrepreneurial personality, we thus expect that founders *without* an entrepreneurial personality profile, which is characterized by high scores in extraversion, conscientiousness, and openness and low scores in agreeableness and neuroticism, utilize business assistance more often and, furthermore, perceive this assistance as more useful than do founders having a more entrepreneurial set of personality traits.

Characteristics of the start-up

In addition to the personal characteristics of the nascent entrepreneur, characteristics of the start-up may affect the take-up and perceived usefulness of business assistance. On the one hand, *team start-ups* should be less in need of business assistance because their internal resources are more substantial to begin with, consisting of an accumulation of all team members' human and social capital (Kamm et al., 1990; Lechler, 2001). On the other hand, having more than one person involved in the founding process has the potential to lead to conflict and advice, in the form of a business assistance program, might be sought due to a "need for decision legitimation" (Cooper et al., 1995, p. 113).

Furthermore, Cooper et al. (1995) find that the need for preparation and legitimacy leads to an increased search for information and increased use of professional assistance. For example, start-up ventures having a high degree of *novelty* are generally more complex due to, e.g., uncertain markets and regulatory requirements and thus innovative ventures and *academic spin-offs* are expected to be accompanied by intensive search activities.

[47] The Terman study is a prospective longitudinal study covering virtually the complete lives of a cohort born in the 1920s. It is widely considered as a landmark study in life-span research.

Highly educated founders of academic spin-offs face high opportunity costs in the form of either foregone earnings in wage employment or time that could have been spent advancing their academic reputation (Goldfarb and Henrekson, 2003). In line with an argument put forward by Holland (1997), business assistance might be helpful in allowing these nascent entrepreneurs to rationalize their entrepreneurial engagement.

Supply-side factors also shape the pattern of policy take-up. The increased policy focus on entrepreneurship led to an increased availability of subsidized business assistance over time. Particularly, there is an extensive range of business support for academic spin-offs, beginning with the EXIST initiative in 1998 (Audretsch and Beckmann, 2007). Moreover, there may be some evidence of policy induced selectivity toward the "weak" founders (i.e., those with few entrepreneurial resources), visible, for example, in schemes targeted at women, minorities, the young, and the unemployed (Lundström and Stevenson, 2005).

Table 3.2 summarizes our hypothesized directions of how founders' personal characteristics and the properties of the start-up will affect the take-up and perceived usefulness of business assistance. The table makes clear why we focus on entrepreneurship-specific human capital, such as self-employed parents, since other human capital variables can be expected to be highly correlated with the novelty of the business idea or being an academic spin-off.

			Take-up and perceived usefulness of business assistance
Characteristics of the founder	Human capital	Previous self-employment	–
		Parents self-employed	
	Social capital		–
	Entrepreneurial personality profile		–
Characteristics of the start-up	Team start-up		**?**
	Novelty / Academic spin-off		+

Table 3.2: Hypothesized directions of how characteristics of the person and the start-up affect take-up and perceived usefulness of business assistance

3.3.3 Economic effectiveness

Publicly financed business assistance is mainly justified by the expectation of positive external effects accruing from better start-up performance of assisted founders or by sociopolitical reasons like the advancement of certain groups, e.g., women, minorities or immigrants (Reynolds, 2007). Following the rationale of positive external effects, public advisory services are effective if they improve start-ups' economic viability so that assisted

start-ups do, indeed, result in positive external effects in the long-run. Assistance provided during the nascent phase has the potential to create long-term benefits (Chrisman and McMullan, 2000) because initial founding conditions and decisions at the pre-start-up stage have been found to leave a long-term impact on subsequent structure (Stinchcombe, 1965) and performance (Bamford et al., 2000; Cooper et al., 1994). However, external effects accruing from individual entrepreneurial activity are very difficult to measure since they include fuzzy indirect effects such as introduction of innovations and securing market efficiency through competition (Fritsch, 2008). Furthermore, positive external effects only become apparent in the long run, with estimated time lags between entrepreneurial activity and subsequent economic performance of up to 10 years (Fritsch and Mueller, 2004; Thurik et al., 2008; van Stel and Suddle, 2007).

Therefore, a venture's capital base, its employment, and long-term survival are often used as proxies for positive external effects in empirical studies (e.g., Chrisman and McMullan, 2000; Chrisman et al., 2005). These measures of success indicate start-ups' economic viability, their knowledge base, and resource strength, which can be viewed as necessary prerequisites for subsequent positive external effects (Fritsch and Schroeter, 2009).[48]

3.4 Empirical analysis

3.4.1 The data

Sample. Data for this study were collected by the Thuringian Founder Study (*Thüringer Gründer Studie*), which is an interdisciplinary project on the success and failure of innovative start-ups in the East German State of Thuringia. The database draws from the commercial register for commercial and private companies (*Handelsregister, Abteilung A/B*) in Thuringia and includes 2,971 start-ups in innovative industries registered between 1994 and 2006. Innovative industries, according to ZEW classification (Grupp and Legler, 2000), comprise "advanced technology" and "technology-oriented services".

The survey population consists of 4,215 founders (first registered owner-managers) who registered a new entry in the *Handelsregister* between 1994 and 2006. This design made it possible not only to interview founders of active companies but also founders of ventures that failed. From the survey population we selected a random sample of 3,671

[48] However, success measures such as survival or growth can only roughly indicate social returns because even failed start-ups may give rise to positive externalities. A failed start-up may have challenged incumbents and given rise to knowledge externalities, e.g., when the ideas and experiences of their former employees become an integral part of products made by successful firms (Audretsch et al., 2007; Fritsch, 2008).

founders to contact. Due to team start-ups, this corresponds to 2,604 start-ups in innovative industries. Between January and October 2008, we conducted 639 face-to-face interviews with solo entrepreneurs or with one member of a start-up team (a response rate of about 25%). Due to a number of exclusions,[49] the present analysis includes 445 start-ups, all founded later than 1993 so as to preclude any effects of German Reunification[50]. The structured interviews were conducted by members of the research project as well as by student research assistants who were trained in several sessions during December 2007. On average, an interview took one and a half hours. The interviews covered a broad set of questions regarding sociodemographic and psychological data of the founder. Moreover, we asked for founder's activities along the founding process. Retrospective data relating to events in the founder's life and business history were collected using guided recall. Specifically, we utilized mnemonic techniques drawn from the Life History Calendar method (Caspi et al., 1996). This method has been shown to collect more valid and reliable retrospective information than traditional questionnaires (Belli et al., 2004).[51]

Measures. 43.6% of founders took-up business assistance along the founding process, which has been defined as the time between the first steps in the start-up project and the first business year. Founders were asked to specify whether they made use of business assistance in regard to formalities, the business plan, financing, a market analysis, or management support. Furthermore, inquiry was made as to the intensity of business assistance used. Definitions of the variables can be found in Table 3.3.

[49] Seventy-three start-ups that turned out not to be genuinely new (e.g., they were a new branch or new business area of an existing company) were removed. A further 18 interviews were deleted due to concerns over interview quality. One-hundred start-ups were founded before 1994. Because of refusals for several variables, the number of observations changes across the analyses.

[50] We defined the first business year as the time when accounting started either because of legal obligations or because of first revenue. This does not necessarily correspond to the date of registration in *Handelsregister*.

[51] We employed a study-specific version of the Life History Calendar, which is a data-collection tool developed by psychologists and sociologists. It is based on the principles of autobiographic memory. This means that – in a first step – we asked interviewees to fill in the timing of well-known life events, sequences, and transitions (e.g., marriage, birth of children, education, or career structure). In a second step, these events served as anchors for the recall of our retrospective study variables.

	Variable	Description
Opera-tional	**Formalities**	This dummy variable indicates whether the interviewed founder received business assistance with regard to formalities concerning the venture set-up.
	Business plan	This dummy variable indicates whether the interviewed founder received practical support for writing a business plan.
	Financing	This dummy variable indicates whether the interviewed founder received business assistance with regard to financing the start-up.
Strategic	**Market**	This dummy variable indicates whether the interviewed founder received business assistance with regard to a market and competitor analysis.
	Management	This dummy variable indicates whether the interviewed founder received business assistance with regard to management issues.
	Intensity	This dummy variable indicates intensity of the interviewed founder's take-up of business assistance along the founding process (in contrast to one-time assistance).

Table 3.3: Variables describing kind and intensity of public business assistance

Table 3.4 sets out the definitions of all other variables and their descriptive statistics.

		mean	sd
Independent variables			
Previous self-employment	This dummy variable indicates whether the interviewed founder was self-employed at any time before the first steps in the founding process.	0.38	0.49
Parents self-employed	This dummy variable captures whether the founder's parents were self-employed.	0.17	0.38
Social capital (strong)	Founders were asked whether they were encouraged by and received emotional support from either close friends and/or relatives *(strong)* or acquaintances *(weak)*, which is denoted by 1 (0 otherwise).	0.37	0.48
Social capital (weak)		0.28	0.45
Entrepreneu-rial personality	We used the German 45-item questionnaire by Ostendorf (1990) to measure Big Five personality traits (extraversion, conscientiousness, openness, agreeable-ness, and neuroticism). Participants had to rate perceived personality attributes using 9 bipolar adjective pairs with Likert scales ranging from 0 to 5 for each trait:		
	Conscientiousness (α=.82), e.g., "Lazy vs. Diligent"	3.65	0.59
	Extraversion (α=.72), e.g., "Uncommunicative vs. Talkative"	3.21	0.61
	Agreeableness (α=.73), e.g., "Good natured vs. Cranky"	3.09	0.57
	Openness (α=.59), e.g., "Conventional vs. Inventive"	3.18	0.55
	Neuroticism (α=.77), e.g., "Vulnerable vs. Robust"	1.37	0.50
Entrepreneu-rial personality profile	As noted earlier, we follow Schmitt-Rodermund's (2004, 2007) definition of an *entrepreneurial personality profile.* Higher values of this variable (meaning values closer to 0) describe a better fit between the individual's Big Five personality profile and the defined ideal type of an entrepreneurial personality. Following Schmitt-Rodermund (2004, 2007) the variable "Entrepreneurial personality" was created as follows. An ideal entrepreneurial personality scores highest (value of 5) in extroversion, conscientiousness, and openness, and lowest (value of 0) in agreeableness and neuroticism. With reference to this ideal type, we estimated the "goodness of fit" of each person's Big Five profile. First, we calculated each person's squared differences between the ideal values and the personal values on each of the five scales. For instance, the squared difference is 9 when a person scored a 3 in neuroticism (because the ideal value is 0). Second, the five squared differences were added up for each person and, third, this sum was reversed. The resulting values then form the final variable *entrepreneurial personality profile*.[52]	-21.4	5.74
Team start-up	Team start-ups are defined as ventures where more than one person was actively involved in the founding process and was intended to become an	0.68	0.47

[52] In contrast to all the retrospective data concerning the firm formation process (which refer to events up to 14 years prior to the time of the interview), the Big Five traits are measured as respondents' current traits. However, due to their high degree of stability, we deem these trait-measures as useful for the present study (Caspi et al., 2005).

	owner of the company. This dummy variable is coded 0 in the case of a single founder, and 1 in the case of a team start-up.		
Novelty	The novelty of the business idea refers to the degree of its newness. Five categories were given: novelty (0), regional or local (1), supra-regional but national (2), European (3), and global novelty (4).	1.31	1.57
Current life satisfaction	Founders' *current life satisfaction* at the time of the interview is measured using a Likert scale from 1 (=lowest satisfaction) to 5 (=highest satisfaction) ("How satisfied are you with your life right now?").	4.02	0.73
Year 1994–1997	Dummy variables that capture the time of business start, i.e., the first business year of the company when accounting started either because of legal obligations or because of first revenue.	0.40	0.49
Year 1998–2001		0.35	0.48
Year 2002–2006		0.24	0.43
	Industry dummies:		
Nace 2	*C*hemical industry, metalworking industry, engineering	0.23	0.42
Nace 3	Electrical engineering, fine mechanics, and optics	0.24	0.43
Nace 7	Information and communication technology, R&D, services	0.36	0.48
Nace x	Miscellaneous industries	0.18	0.38
Dependent variables			
Usefulness	Founders' perceived *usefulness* of business assistance was measured for each kind of assistance used (e.g., assistance concerning formalities or financial assistance) using a 5-point Likert scale with 5 (1) denoting the highest (lowest) perceived usefulness of business assistance. The mean of these ratings reflects an overall subjective evaluation of actual business assistance.	3.48	1.17
Initial capital	The start-up's *initial capital* (i.e., at the beginning of the first business year) was asked for with the help of the following categories: 1,000 EUR or less (1), more than 1,000 to 10,000 EUR (2), more than 10,000 to 50,000 EUR (3), more than 50,000 to 100,000 EUR (4), more than 100,000 to 250,000 EUR (5), more than 250,000 to 500,000 EUR (6), more than 500,000 EUR (7).	3.34	1.32
Employment	*Employment* in the third business year is defined as number of positions staffed by founders, active partners, conventional employees, hired labor, and trainees. The measure is normalized on full-time positions, thereby considering part-time jobs.	9.16	11.99
Credit rating	We obtained a start-up's *credit rating* three years after founding from Creditreform, the leading rating agency in Germany. The variable *credit rating* thus contains Creditreform's rating index, which ranges from 100 (best) to 600 (worst). Creditreform uses several sources of information in making its ratings, for example, financial and structural risks such as industry, firm size, and productivity, as well as payment history, quantity of orders, firm development, and management quality.[53] The credit rating aims to proxy the start-up's default risk and, indeed, credit rating and survival are highly correlated in the present sample (r: -0.20, p = 0.000). The credit rating thus serves as a continuous variable for the highly skewed dichotomous variable survival.[54]	287.93	75.72
Note. α refers to Cronbach's alpha, which is an indicator of reliability			

Table 3.4: Definition of variables and descriptive statistics

[53] For more information on Creditreform's credit rating system, see Czarnitzki and Kraft (2007).

[54] Creditreform does not routinely generate credit ratings for each new start-up, but only when there is an external request from other firms. Because of missing credit ratings, we have to exclude 77 observations when analyzing the outcome variable *Credit rating*. These nonrated start-ups turn out to have significantly less initial capital and to be less often team start-ups than the rated start-ups. Hence, it should be borne in mind that the credit rating might imply a systematic bias in favor of the larger start-ups. Due to data availability there are also significantly fewer rated start-ups founded between 1994 and 1997.

3.4.2 Empirical clusters of policy take-up

We investigate whether there are groups of founders who take up business assistance in a similar pattern regarding scope and intensity. Therefore, we perform an explorative cluster analysis to sort start-ups based on similarities in their take-up of policy support along the founding process (thereby employing all dummy variables set out in Table 3.3). Cluster analysis is a multivariate technique that sorts different objects into groups by maximizing within-group similarities and between-group differences. The identification of clusters is thus empirically based instead of guided by theory.

We perform a cluster analysis using the "matching" similarity measure and employing Ward's algorithm. This hierarchical method groups the original observations (stage by stage) in more aggregated groups in order to minimize the internal variance (within each group) and to maximize the intergroup variance with regard to all dummy variables describing take-up of business assistance (as given in Table 3.3). Ward's method has been shown to provide generally good results compared to other clustering methods (Milligan and Cooper, 1987). The results are presented in the dendrogram in Figure 3.1, which shows at which levels of similarity observations are grouped. Starting from the bottom, more and more clusters are grouped together when lower levels of similarity are accepted (StataCorp, 2003). A visual inspection of the dendrogram suggests two different groups of policy take-up. The observations within these two groups have at least a similarity level of -6.9.

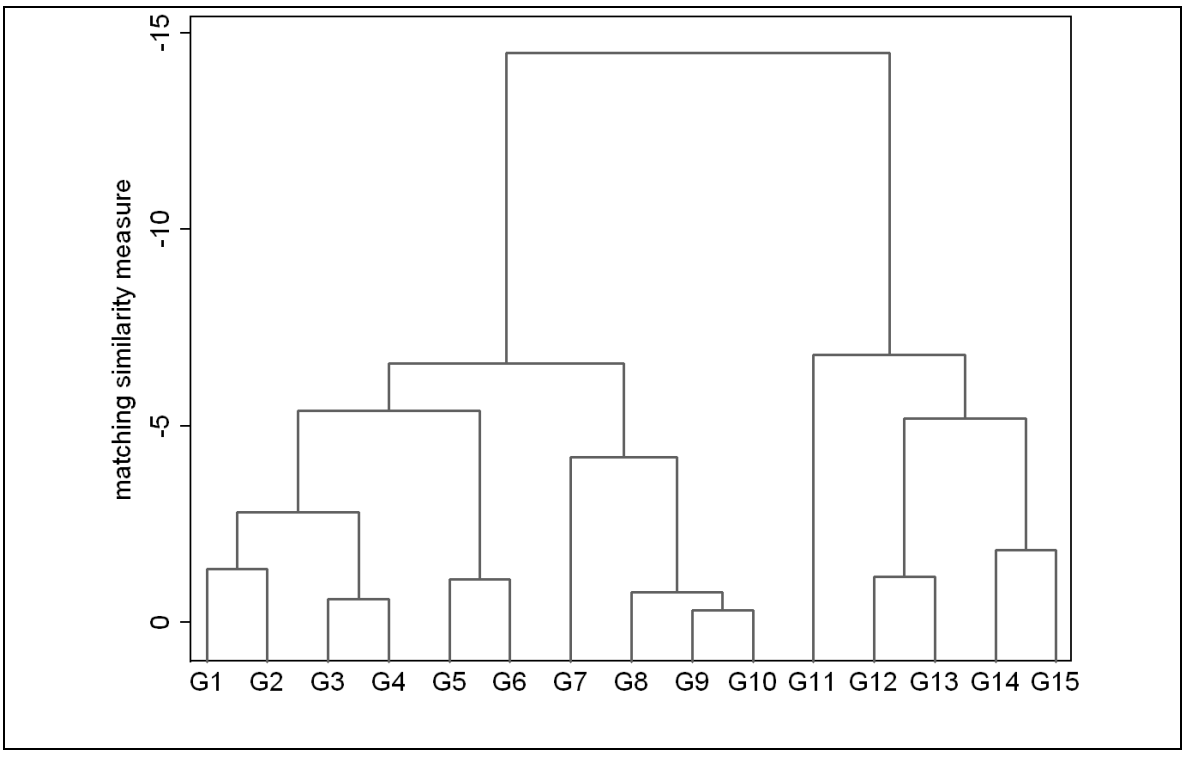


Figure 3.1: Dendrogram using Ward's method

Table 3.5 provides descriptive statistics on overall policy take-up and for each of the identified clusters. The clusters are compared using one-way ANOVA, which exhibits group differences in the take-up of each policy instrument that are significant at the 0.001 level.

		Variables						N
		Formali-ties	Business-plan	Financing	Market	Manage-ment	Intensity	
Business assistance in general	mean	0.742	0.367	0.461	0.207	0.218	0.428	194
	sd	0.439	0.483	0.500	0.406	0.414	0.496	
Cluster 1	mean	0.688	0.726	0.490	0.417	0.438	0.552	96
	sd	0.466	0.448	0.503	0.496	0.499	0.500	
Cluster 2	mean	0.796	0	0.433	0	0	0.306	98
	sd	0.405	0	0.498	0	0	0.463	

Table 3.5: Descriptive statistics on take-up of business assistance – overall and separately for each cluster

The pattern of policy support can be thus characterized as follows:

Cluster 1. Intense assistance across all areas.

Cluster 2. One-time assistance in operational issues (formalities and financing).

Self-reported reasons for non-take-up confirm our conjecture of strong self-selection into these clusters of policy take-up: "no interest/need" is the overwhelming reason for non-take-up of business assistance, given in 70.5% of the non-take-up cases.[55] In 18.8% of non-take-up cases, business assistance schemes were "not available/known" to founders. Reasons related to policy-induced selectivity play virtually no role.

3.4.3 Predictors of policy take-up and perceived usefulness

Having identified empirical clusters of policy take-up, we now analyze which characteristics of founders and their start-ups explain the use of business assistance in general as well as separately for each particular pattern of business assistance, that is, for Cluster 1 and Cluster 2. We then examine the predictors of perceived usefulness, again first for business assistance in general and then for each cluster.

Policy take-up

To predict the type of policy take-up, we employ logistic regression and multinomial logistic regression analysis estimating odds ratios (OR). This procedure allows estimating the sample-specific likelihood of being in the assistance groups, instead of the

[55] The reasons for non-take-up were asked for each kind of business assistance separately. The percentages were calculated by adding the respective responses across the five subject matters.

nonassistance group, as a function of the independent variables. Significant ORs that are higher than 1 indicate a positive effect and significant ORs lower than 1 indicate a negative effect. Note that each regression is conducted in two steps (denoted by Roman numerals): the first step considers founders' *Entrepreneurial personality profile*, the second step, as an additional analysis, considers the single Big Five traits instead of the profile.

The independent variables are control variables (*Year 1994–1997, Year 1998–2001*), our hypothesized predictors, namely, variables tapping nascent founders' human and social capital as well as personality, and, finally, variables referring to the type of start-up. The results are set forth in Table 3.6. The results from logistic regression analysis reveal that *Previous self-employment* is a relevant predictor of the overall assistance group (OR=0.48). Founders who had prior experience at the time they founded the venture in question are less likely to be in the overall assistance group than in the nonassistance group. Academic spin-offs are also more likely to receive business assistance.[56]

The multinomial logistic regression analysis (which predicts use of assistance in Clusters 1 and 2) further reveals that *Previous self-employment* and *Novelty* are relevant predictors of assistance for both clusters. Specifically, *Previous self-employment* predicts both clusters. Founders with prior experience are less likely to be in either cluster than in the nonassistance group. In contrast, the *Novelty* of the business idea solely predicts inclusion in Cluster 1. Founders who start a business based on a novelty are more likely to be in Cluster 1 than in the nonassistance group. Similarly, being an *Academic spin-off* sharply increases the probability of taking up business assistance, that is, of being in Cluster 1. The coefficients of *Year 1994–1997* are significantly negative in both regressions (i.e., OR below 1) and thus indicate that start-ups whose first business year was not later than 1997 made less use of business assistance, which is probably due to the sparser range of public assistance schemes available at that time.

In sum, these findings provide some support for our expectations. Consistent with our "weakness hypothesis", founders who had low personal entrepreneurial resources (i.e., no entrepreneurial experience at the time they began founding the venture in question) utilized public business assistance more often than those with some experience. However, all other variables tapping personal entrepreneurial resources appear to be irrelevant predictors. Regarding variables that cover the type of start-up, we find no evidence that being a team start-up rather than a sole founder has any effect on the take-up of business

[56] Because of the high correlation between the variables *Novelty* and *Academic spin-off* we ran separate regressions for estimating the effects of each variable (not shown here). Overall, coefficients changed only slightly when *Academic spin-off* replaced *Novelty*.

assistance. However, the variable might be insignificant because of two conflicting underlying mechanisms, which were discussed in Section 3.3.2. Unfortunately, we cannot empirically distinguish between team start-ups' potentially lower need of business assistance and their higher need for legitimizing decision making, which would tend to increase take-up of business assistance.

		Logistic regressions		Multinominal regressions			
		(I)	(II)	(I)		(II)	
		Assistance in general	Assistance in general	Cluster 1 – assistance vs. no assistance	Cluster 2 – assistance vs. no assistance	Cluster 1 – assistance vs. no assistance	Cluster 2 – assistance vs. no assistance
		OR	OR	OR	OR	OR	OR
Con-trols	Year 1994–1997	0.42*** (0.25-0.72)	0.43*** (0.25-0.74)	0.31*** (0.16-0.61)	0.56* (0.29-1.07)	0.31*** (0.15-0.61)	0.57* (0.30-1.11)
	Year 1998–2001	0.72 (0.42-1.21)	0.73 (0.43-1.24)	0.70 (0.37-1.31)	0.74 (0.38-1.44)	0.69 (0.36-1.31)	0.78 (0.40-1.52)
Human and social capital	Previous self-employment	0.48*** (0.31-0.73)	0.48*** (0.31-0.73)	0.42*** (0.24-0.73)	0.54** (0.32-0.92)	0.41*** (0.23-0.73)	0.54** (0.32-0.92)
	Parents self-employed	0.81 (0.47-1.40)	0.82 (0.47-1.41)	0.87 (0.43-1.76)	0.77 (0.39-1.51)	0.89 (0.43-1.82)	0.75 (0.38-1.50)
	Social capital (weak)	1.31 (0.83-2.06)	1.32 (0.84-2.08)	1.55 (0.88-2.74)	1.14 (0.65-1.99)	1.61 (0.91-2.86)	1.14 (0.65-1.99)
	Social capital (strong)	1.12 (0.73-1.72)	1.12 (0.73-1.72)	1.04 (0.60-1.80)	1.19 (0.71-1.99)	1.03 (0.59-1.80)	1.17 (0.70-1.97)
Personality traits	Conscientious-ness		0.85 (0.58-1.24)			0.74 (0.45-1.21)	0.93 (0.59-1.48)
	Extraversion		1.00 (0.69-1.44)			0.88 (0.55-1.42)	1.12 (0.72-1.75)
	Agreeableness		1.05 (0.73-1.52)			0.91 (0.56-1.45)	1.21 (0.77-1.91)
	Openness		1.07 (0.71-1.60)			1.16 (0.69-1.93)	1.00 (0.61-1.64)
	Neuroticism		1.09 (0.69-1.72)			1.17 (0.64-2.14)	1.03 (0.60-1.79)
	Entr. personality profile	0.99 (0.95-1.02)		0.98 (0.93-1.03)	0.99 (0.95-1.04)		
Type of start-up	Novelty	1.08 (0.95-1.23)	1.07 (0.94-1.22)	1.31*** (1.12-1.54)	0.87 (0.73-1.03)	1.30*** (1.11-1.52)	0.86 (0.72-1.03)
	Team start-up	0.83 (0.54-1.27)	0.83 (0.54-1.28)	0.78 (0.45-1.36)	0.86 (0.51-1.44)	0.76 (0.44-1.32)	0.86 (0.52-1.45)
N		425	425	425		425	
LR chi2		29.21***	29.74***	52.65***		56.81***	
Pseudo R2		0.050	0.051	0.063		0.145	

Note: * p < 0.1; ** p < 0.05; *** p < 0.01.
OR = odd ratios (odds of belonging to Cluster 1 (Cluster 2) as compared to having no business assistance).
95% confidence intervals are given within parentheses.
Reference group in the multinomial logistic regression: No business assistance.
Refusals for several variables reduce the number of observations to 425.

Table 3.6: Logistic and multinomial logistic regressions describing selection into business assistance in general and into particular clusters of business assistance

Perceived usefulness

We now turn to investigating predictors of founders' perceived usefulness of the business assistance utilized. In a preliminary analysis, we test whether this usefulness differs between the two clusters. It does: perceived usefulness is significantly higher in Cluster 1 (mean: 3.69, sd: 0.95) than in Cluster 2 (mean: 3.28, sd: 1.32)[57], which can be interpreted as a result of the different kind of take-up. Founders' dissatisfaction about first business assistance will most likely result in no further use of these services, partly explaining the take-up patterns described by Cluster 2. In other words, founders' higher satisfaction in Cluster 1 might, on the one hand, be due to self-selection into intense assistance, or, on the other hand, it might result from benefiting from intense rather than one-time assistance.

In a next step, we conduct three single regression analyses (again via two steps denoted by Roman numerals) to examine the influence of founders' human and social capital, their personality, and the type of the start-up on the perceived usefulness of their utilized business assistance. The first regression analysis refers to the overall sample, i.e., to all founders who made use of any kind of business assistance; the second refers to founders in Cluster 1; and the third to founders in Cluster 2. This procedure allows to explore effects within the overall sample as well as cluster-specific effects. Independent variables are control variables and the same set of predictors that were used to predict type of take-up (Section 4.3.1). Note that we additionally consider founders' *Current life satisfaction* as a control variable in order to adjust our results for a possible recall bias. As the dependent variable represents retrospective data, namely, founders' current evaluations of business assistance they had utilized months or even years ago, this information could be biased by founders' current state of mind, e.g., current life satisfaction (Rutter et al., 1998).

Table 3.7 summarizes the results of the three regressions (overall sample and the subgroup analyses for Clusters 1 and 2). Founders' *Current life satisfaction* positively predicts usefulness in Cluster 1. Thus, those founders in Cluster 1 who felt happy with their current life perceived the utilized business assistance as more useful. Among the study variables, previous self-employment, self-employed parents, social capital (weak), and personality (an entrepreneurial personality profile and openness, respectively) are relevant predictors in at least one of the groups. Specifically, *Previous self-employment* negatively predicts usefulness in the overall sample; *Parents' self-employment, Social capital (weak)*, and an *Entrepreneurial personality profile* negatively predict usefulness in Cluster 1.[58]

[57] A two-sided t-test reveals significance at the 5 % level.

[58] Interestingly, we find that a lack of support from weak ties leads to higher perceived usefulness in Cluster 1, whereas a lack of support from strong ties has no effect. This somewhat counterintuitive result might reflect that founders' fairly remote but larger networks within the venture creation process serve as bridges to

Furthermore, *Openness* negatively predicts usefulness in the overall sample and in Cluster 1. Taken together, these results are in line with our expectations. Founders with low personal entrepreneurial resources perceived their utilized business assistance as more useful. This was particularly true within Cluster 1. Insignificant coefficients in the analysis of Cluster 2 indicate that the usefulness of one-off operational assistance does not depend on any of the personal entrepreneurial resources (apart from *Previous self-employment*) or the start-up characteristics we analyze.

Interestingly, among the single broad personality traits studied, openness turned out to be relevant. Founders who lack creativity and openness to the new appear to have benefited from business assistance, particularly from intense assistance. As suggested by past research, higher levels of openness should be understood as a personal entrepreneurial resource (Zhao and Seibert, 2006). Openness could be a particularly valuable resource in the venture-founding process, which often demands high levels of creativity and openness to the new (Ardichvili et al., 2003). Moreover, as we already showed that founders who utilized business assistance were very often novice entrepreneurs without previous entrepreneurial experience, openness could have been particularly crucial for them, as they had to adapt to a new and complex occupational field – the entrepreneurial arena. While the novelty of the business idea has been shown to be a strong predictor of whether business assistance is taken up at all, insignificant coefficients indicate that start-ups' innovativeness does not have an impact on the perceived usefulness of the assistance.

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various types of information and help, making more formal business assistance less useful (Granovetter, 1973).

		Business assistance in general		Subgroup analysis for each cluster			
		Overall (N=194)		Cluster 1 (N=96)		Cluster 2 (N=98)	
		(I)	(II)	(I)	(II)	(I)	(II)
Cons.		2.70 ***	4.12 ***	1.99 ***	2.75 **	3.10 **	4.27 *
Controls	Current life satisfaction	0.19	0.16	0.40 ***	0.33 **	0.18	0.19
	Year 1994–1997	-0.02	-0.07	-0.28	-0.19	0.10	-0.14
	Year 1998–2001	0.06	0.08	-0.02	0.16	0.20	0.01
Human and social capital	Prev. self-employment	-0.37 *	-0.38 *	-0.40	-0.38	-0.34	-0.42
	Parents self-employed	-0.08	-0.15	-0.47	-0.60 *	0.35	0.38
	Social capital (weak)	-0.07	-0.07	-0.53 **	-0.57 **	0.30	0.29
	Social capital (strong)	0.13	0.11	-0.13	-0.13	0.39	0.36
Personality traits	Conscientiousness		0.02		0.05		0.06
	Extraversion		0.09		0.13		0.17
	Agreeableness		-0.08		0.23		-0.27
	Openness		-0.30 *		-0.37 **		-0.33
	Neuroticism		-0.27		-0.06		-0.37
	Entr. personality profile	-0.00		-0.03 *		0.03	
Type of start-up	Novelty	0.01	0.02	-0.02	0.01	-0.12	-0.12
	Team start-up	0.03	0.03	0.15	0.19	-0.17	-0.22
R2		0.045	0.070	0.255	0.291	0.107	0.136
Adjusted R2		-0.013	-0.010	0.155	0.150	-0.003	-0.021

Note: * p < 0.1; ** p < 0.05; *** p < 0.01.

Table 3.7: Prediction of perceived usefulness of business assistance (ordinary least squares regressions)

Additionally, we test for interaction effects between each (independent) study variable and belonging to either Cluster 1 or Cluster 2. In other words, we test cluster membership as a moderator (Baron and Kenny, 1986). This procedure allows examining whether the effect of each independent study variable significantly differs between the two clusters. Employing moderated multiple regression analysis (for continuous independent variables) and ANOVA (for dichotomous independent variables), we find two significant interaction effects ($p<0.10$). The effect of *Novelty* and *Social capital (weak)* on perceived usefulness differs significantly depending on being in Cluster 1 or Cluster 2. These significant interactions thus support our initial conjecture that distinct differences in policy take-up, as depicted by our two clusters, deserve separate attention. Finally, we should note that none of the predictors achieved significance in Cluster 2, which can be explained by the various reasons given for having had only one-time assistance, again suggesting diverse predictors of perceived usefulness.

3.4.4 Economic effects

The previous section highlighted a person-focused view of actual take-up of business assistance and its perceived usefulness. From an economic perspective (and abstracting away from policy efforts to promote the economic status of disadvantaged groups), business assistance is mainly justified by positive external effects accruing from superior business performance and thus must be evaluated accordingly.[59] We approximate positive external effects by a start-up's initial capital, its employment, and survival. First, business assistance might provide founders with the necessary commitments and signals to overcome alleged credit rationing (Blumberg and Letterie, 2008) and, therefore, business assistance might help founders to attract external finance. Initial firm size is consistently found to be associated with firm survival (Geroski, 1995; Sutton, 1997). Proxied by the amount of initial capital, it can thus be seen as an indicator for positive external effects. Cooper et al. (1994) argue that financial resources allow start-ups to pursue more capital-intensive strategies (which might be more efficient and better protected from imitation) and to realize growth. Furthermore, financial resources constitute a buffer against random shocks. Start-ups with high endowments of financial capital are thus able to mount a greater challenge to incumbents and, in this way, will ensure efficiency and stimulate productivity (Fritsch, 2008). Second, business assistance should enable founders to manage and grow their enterprises. Employment growth is a prominent indicator of firm growth and prosperity and, moreover, constitutes an important policy goal itself. Third, the long-run survival of a start-up indicates a sustainable policy intervention.[60]

Matching approach

Since the weaker founders seem more likely to make use of business assistance, the performance of assisted and nonassisted start-ups cannot be compared directly to identify the causal effect of business assistance. Therefore, the counterfactual outcome must be discovered, that is, the outcome of a nonassisted start-up if it took up business assistance.

Nonparametric matching methods produce unbiased estimates of a treatment's impact, for example, when estimating the effect of a particular policy intervention. The basic idea is to compare the mean outcome of assisted firms with those of nonassisted start-ups that are similar in terms of a predefined set of ex-ante variables but that have not taken up any business assistance. Given that the selection into business assistance is completely

[59] As already discussed in footnote 39 a lack of recognition and asymmetric information are also put forward as a rationale for the public provision of business assistance (Storey, 2003).

[60] However, as already pointed out by footnote 48 positive external effects can also emanate from failed start-ups.

based on observable exogenous characteristics (i.e., not affected by the treatment), potential outcomes are independent of the treatment assignment (Smith and Todd, 2005). This assumption is known as the conditional independence assumption (CIA). Implicit in this matching approach is the stable unit treatment value assumption (SUTVA), which states that business assistance does not impact any start-ups other than those explicitly treated (Rubin, 1991). In the present context, this implies that business assistance does not impact nonassisted start-ups via market effects or knowledge spillovers.

In principle, one can match on all covariates. However, this may be difficult to implement when the set of covariates is large. To reduce the size of the matching problem, Rosenbaum and Rubin (1983) propose using propensity score matching. The basic idea is not to match on covariates directly, but to match on a function of the covariates that describes the propensity to take-up assistance. As actual propensity scores are not known, the first step in a propensity score analysis is to estimate the individual scores, which is usually done by logistic regression.

In a second step, a matching algorithm must be chosen that contrasts the outcome of an assisted start-up with a weighted average of the outcome of (some) nonassisted observations. There are various matching algorithms that, asymptotically, should all yield the same results (Smith, 2000). In the present analysis, we apply kernel matching. This method matches every assisted start-up with the weighted average of all nonassisted start-ups. Thereby, the weights are inversely proportional to the distance between the propensity scores of the assisted and nonassisted start-ups. When implementing kernel matching, a kernel function and a bandwidth parameter need to be chosen. The choice of the latter is of most importance in practice (DiNardo and Tobias, 2001) since the bandwidth parameter determines a tradeoff between a “few but good matches” (yielding higher variance) and “many but potentially bad matches” (leading to biased estimates). Here, Silverman’s (1986) rule of thumb is used to determine the bandwidth parameter and thus to balance bias and variance. The exact matching protocol is set out in Table 3.8. Estimations are made with the psmatch2 Stata ado package by Leuven and Sianesi (2003).

Step 1. A logit model for all three outcome variables (initial capital, employment, and credit rating) is specified and estimated. In this way, the propensity scores for each observation are obtained. The choice of variables and the estimation of the propensity score are explained in Appendix B.2.

Step 2. The sample is restricted to the region of common support. The common support condition ensures that any set of characteristics of assisted start-ups (as captured by the propensity score) can also be observed for nonassisted ones. A minimum-maximum comparison of the distribution of the propensity score determines the region of common support. Its imposition requires dropping 3 (8, 7) observations from the analysis of business assistance overall (Cluster 1, Cluster 2).

Step 3. The average treatment effect on the treated (ATT) is the difference between the mean outcome of assisted start-ups and matched nonassisted start-ups. The average treatment effect for the treated (ATT) can be stated as $ATT = \frac{1}{N_1}\sum_{i \in I_1}[Y_i^1 - \sum_{j \in I_0} W_{N_0}(i,j)\, Y_j^0]$, with Y_i^1 denoting the outcome of the assisted start-up i and Y_j^0 the outcome of nonassisted start-ups j.[61] N_1 (N_0) is the number of observations in the assisted group I_1 (control group I_0). The outcome of i is thus contrasted with a weighted average outcome of the control group. Weights are given by $W_{N_0}(i,j) = \frac{G_{ij}}{\sum_{k \in I_0} G_{ik}}$, with G_{ik} denoting a Gaussian kernel $G[(P_i - P_k)/h]$ and P_i (P_k) standing for the propensity score of assisted (nonassisted) start-ups. Silverman (1986) developed the following rule of thumb for the choice of the bandwidth parameter: $h: h = 0.9 \cdot A \cdot n^{-0.2}$, in which n denotes the number of observations and the term $A = \min(standard\ deviation, \frac{interquartile\ range}{1.34})$ accounts for the distribution of the propensity score.

Step 4. The standard error of the matching estimators is calculated using bootstrapping (200 replications).[62] The estimates for the average treatment effect (ATT) as well as their bootstrapped standard errors and p-values are set out in Table 3.9.

Step 5. The quality of the matching is assessed by analyzing the mean differences between nonassisted and assisted matched start-ups. After matching, there should be no significant differences regarding any characteristics that are assumed to have an impact on both the take-up of assistance and the respective outcome variable. Appendix B.4 shows mean comparisons between assisted and nonassisted start-ups.

Step 6. Steps 1 to 5 are conducted for the following treatments: "business assistance in general" and, more specifically, the effectiveness of business assistance as characterized by Cluster 1 as well as by Cluster 2 is examined.

Table 3.8: Matching protocol

Results

The matching results with respect to the three outcome variables for each sample (overall, Cluster 1, Cluster 2) are set out in Table 3.9. Looking first at the analysis of business assistance in general, we find that start-ups taking up business assistance have, on average, initial capital amounting to 3.28. Their matched nonassisted counterparts, however, have even higher initial capital (3.30), pointing to a negative effect of business assistance. This difference is not significant. Similarly, the employment growth of assisted start-ups exhibits an ATT of -1.69, i.e., the difference between the mean employment growth of assisted start-ups (8.19) and matched nonassisted start-ups (9.88). Again, the higher employment growth of assisted start-ups is not significant. Looking at the indicator for

[61] This notation follows Caliendo (2006).

[62] Although a distribution theory for the cross-sectional and difference-in-difference kernel and local linear matching is derived in Heckman et al. (1998), standard errors for matching estimators are in practice generated using bootstrap resampling methods. The use of bootstrapping is supported by Abadie and Imbens (2008), who suggest that the standard bootstrap can be applied to assess the variability of kernel matching estimators.

survival, assisted start-ups have a mean credit rating of 287.66 compared to the mean rating of 285.56 for their nonassisted matched counterparts. However, the difference fails to reach significance. The same tendencies can be observed when we look at the effects of business assistance as characterized by cluster 1. Again, matching does not reveal any significant differences with respect to initial capital, employment, or credit rating. Business assistance as characterized by Cluster 2 does not significantly affect our outcome variables either. However, the amount of initial capital (the credit rating) is higher (better) for assisted start-ups compared to their nonassisted counterparts (insignificantly, though). The use of other bandwidth parameters and other matching algorithms also results in insignificant estimates.

Outcome		Mean outcome of matched		ATT	S.E.	p-value	#Observations	
		… Assisted start-ups	… Non-assisted start-ups				Assisted	Non-assisted
Overall	**Initial capital**	3.28	3.30	-0.02	0.14	0.89	189	249
	Employment	8.19	9.88	-1.69	1.04	0.11	186	239
	Credit rating	287.66	285.56	2.09	7.15	0.77	161	202
Cluster 1 business assistance	**Initial capital**	3.29	3.34	-0.05	0.19	0.80	93	239
	Employment	8.16	10.01	-1.85	1.16	0.11	91	229
	Credit rating	293.37	286.87	6.50	10.51	0.54	82	192
Cluster 2 business assistance	**Initial capital**	3.36	3.35	0.02	0.17	0.93	97	238
	Employment	8.35	9.91	-1.56	1.30	0.23	96	229
	Credit rating	279.94	281.34	-1.40	9.15	0.88	80	193
Please note that no estimate reaches the 0.1 significance level.								

Table 3.9: Overview of results obtained from kernel matching (employing optimal bandwidth parameters)

The matching procedure thus cannot reveal any impact of business assistance on venture performance (measured by initial capital, employment, and credit rating) and thus cannot indicate any positive external effects created by business assistance schemes. Abstracting away from insignificant differences, the outcomes of matched assisted start-ups are most of the times inferior to those of matched nonassisted start-ups (in terms of having lower initial capital, lower employment, and a worse credit rating). This tendency either suggests that business assistance induces start-ups to grow more slowly (leading to less employment after three years or to invest less capital). But, then, it also points to the conditional independence assumption, which might not be met in the present analysis. The validity of the conditional independence assumption relies crucially on the possibility of comparing assisted and nonassisted start-ups on the basis of a broad set of pre-treatment characteristics. We have a rich dataset and the matching succeeds in leveling out any

differences with regard to, e.g., being an academic spin-off, the degree of novelty, previous self-employment, and social capital. However, there might be yet unobserved characteristics that explain the weak performance of assisted start-ups. Unfortunately, the very nature of the conditional independence assumption means that it cannot be tested.

However, unobserved differences between assisted and nonassisted start-ups would have to be very strong to be able to turn insignificant negative ATTs into significant positive ATTs. Therefore, we are confident in suggesting that business assistance does not impact on start-ups' performance as measured by initial capital, employment growth, and credit rating.

3.5 Discussion and conclusions

By providing business assistance to nascent entrepreneurs, policymakers intend to help nascent founders develop and grow viable businesses. Given that start-up quality matters for inducing positive external effects in the long-run, the hope is to *"build winners"* who will later contribute to structural change and economic growth. However, our analysis cannot identify any impact of business assistance in the nascent phase on subsequent business performance. Propensity score matching suggests that business assistance neither impacts the amount of initial capital at the beginning of the first business year, nor employment or credit rating after three years. Our analysis reveals distinct patterns in the use of business assistance – irrespective of particular assistance schemes. If founders make use of business assistance at all, it can be described either as intensive strategically-oriented support (Cluster 1) or one-off operational assistance (Cluster 2). Even for the more intense and strategically-oriented business assistance described by Cluster 1, which is taken up by founders of more innovative start-ups (especially academic spin-offs), we could not find any effect on subsequent business performance. Starting up this type of venture can be expected to be the most difficult and at the same time the most socially desirable (yielding positive external effects), which explains the increased policy focus on this type of start-up. Our analysis suggests that this policy interest has been successfully implemented, since academic spin-offs and innovative start-ups are more likely to make use of Cluster 1. Therefore, the lack of impact on our three outcome measures is unlikely to be explained by a bad person-treatment-fit, i.e. by the fact that business assistance was not used by the target group but by clients towards whom the assistance is not oriented.

We should note that our analyses do not indicate that every individual scheme is ineffective in improving clients' start-up performance. We rather find that, *on average*, the

various kinds of business assistance schemes (which were delivered between 1994-2006 in Thuringia) do not impact performance (as measured by well-established and comprehensive indicators such as start-ups' amount of initial capital, their employment, and credit rating). Given the volume of public expenditure on business assistance schemes, this finding should provide ample opportunity for discussing the scope and intensity of public business assistance schemes, their expected effects and the justification of their public funding.

In addition to the economically-oriented focus on subsequent business performance, we also focus on founders' perceived usefulness of the utilized business assistance. Against the backdrop that a lot of founders reported very useful assistance, concluding that business assistance (on average) is not helpful at all, or has no impact at all, might be premature – at least from the founders' perspective. Note that the fact that intensive strategically-oriented assistance (Cluster 1) is, on average, perceived as more useful compared to less intensive operational assistance (Cluster 2) suggests a positive dose-response-relationship, which underscores the idea that business assistance indeed has an effect. Regarding the nature of this effect, we find that the weaker founders in Cluster 1 perceive business assistance as more useful. Entrepreneurial weakness was reflected by a lack of human and social capital, as well as by lack of an entrepreneurial personality make-up. Accordingly, business assistance could be, first and foremost, *effective in supporting these weak founders in the nascent phase*, helping them overcome barriers, continue the firm formation process, and, finally, to become actual entrepreneurs.

Further research is thus urged to track nascent entrepreneurs along the founding process to estimate the effect of business assistance on getting start-up projects started (we cannot test for such a mechanism because we only have data on young entrepreneurs, i.e., those founders who finally succeeded in completing the nascent phase (survivor bias)). However, business assistance schemes should be considered successful only when they help weak nascent founders start and grow economically viable ventures. This implies that business assistance must sustainably compensate for and develop entrepreneurial resources that are argued to impact entrepreneurial success at the micro level (e.g., Markman and Baron, 2003) as well as fostering structural change and economic growth at the macro level (e.g., Fritsch and Schroeter, 2009). Otherwise, the provision of business assistance runs the risk of enabling weak founders to continue in the firm formation process when they otherwise would not have and who are most likely to run marginal businesses. This effect might be (although insignificantly) indicated by the lower employment growth of assisted start-ups in our sample. However, even if sociopolitical reasons for the public provision of

business assistance prevail (i.e. efforts to promote the economic status of disadvantaged groups), the impact of business assistance should translate into economically viable ventures. Therefore, it will be a fruitful approach to examine assistance schemes' role in discouraging less promising start-up projects and thus allocating overall resources more efficiently.

A closer look at actual policy take-up as identified by our clusters reveals further insights for policymakers. The provision of one-off operational assistance (Cluster 2) points either to an excessive focus on operational assistance, which lacks a clear rationale for public intervention, or to deficiencies in the delivery of strategic assistance, which thus yields too many dropouts. On the one hand, the public provision of operational advice is questionable from a theoretical point of view. In contrast to strategically-oriented assistance, one-off operational assistance is unlikely to impact on long-run business performance. Furthermore, operational services are hardly affected by ex-ante information asymmetries regarding the benefits of their use. Therefore, one-off operational assistance could be most likely effectively and efficiently provided by, e.g., private consultants, accountants, or lawyers (Hjalmarsson und Johansson, 2003). On the other hand, the use of business assistance as characterized by Cluster 2 might also indicate poor policy delivery of strategic assistance. The generally lower perceived usefulness of assistance in Cluster 2 might be due to unsatisfied founders dropping out of assistance that was originally intended to be more strategically-oriented. Taken together, even when abstracting away from particular schemes, the explored take-up patterns suggest the potential for policy improvements.

Our analysis has several limitations. First, our cross-sectional analysis is mainly based on retrospective data. Although we adopted the Life History Calendar method to facilitate the recall process and to ensure the validity of our data (Belli et al., 2004; Caspi et al., 1996), longitudinal data and experimental designs are needed to strengthen causal inferences of business assistance. Second, we suffer from small sample sizes, especially when analyzing cluster-specific effects of business assistance on subsequent business performance. Third, our analysis lacks data about the use of nonsubsidized assistance, such as lawyers or nonsubsidized business consultants, who are most likely substitutes for publicly financed business assistance. Likewise, we did not examine business assistance in the start-up and post-start-up phase. We thus cannot generalize our results for these types of business assistance.

To sum up, on the one hand we cannot find effects of utilized business assistance on venture performance. On the other hand, intensive and strategically-oriented business

assistance was taken-up and was perceived as useful when founders had low entrepreneurial resources. In other words, some founders seem to benefit from particular assistance (i.e., they perceive business assistance as useful), whereas useful business assistance does not seem to translate into subsequent start-up performance. Our findings thus contribute to a better understanding of whether and, if yes, in which cases assistance might support the individual founder in the founding process. However, if further research cannot reveal that business assistance is finally reflected in superior business performance, the economic rationale for the public provision of business assistance breaks down.[63]

Finally, we believe that our evaluation approach effectively tackled the bewildering range of ever-changing policy schemes. However, less fragmented business assistance schemes would clearly facilitate quantitative evaluations by providing a meaningful number of cases. Our analysis thus points to the need to restructure the overall provision of business assistance and to consider means of evaluating it when designing and implementing policies, e.g., by realizing more experimental designs to strengthen causal inferences. Therefore, a stronger "evaluation spirit and culture" at all levels of policy design, implementation, and delivery is needed.

[63] This holds true when positive external effects accruing from innovative and economically viable start-ups are put forward as a rationale for policy intervention.

4. Picking the winner? Empirical evidence on the targeting of R&D subsidies to start-ups[64]

4.1 Introduction

Policy measures which aim to foster innovative activity in young and/or small firms have become increasingly popular among policymakers. Screening relevant policy programs delivers a great variety of different schemes on the regional, national and European level[65]. This points to a major issue in policy making: the targeting of programs. Targeting is defined as designing policy programs with respect to certain target groups. Looking at both regional and national support schemes that are targeted at private research and development (R&D), Blanes and Busom (2004) find that funding authorities pursue different allocation rules.

The allocation of subsidies has important implications for policy effectiveness and efficiency. First, the distinguishing characteristics of subsidized and nonsubsidized ventures have to be identified to estimate the effectiveness of R&D subsidies. Otherwise, better (worse) performance of subsidized projects might be attributable to different pre-treatment characteristics. Second, the targeting of policy measures also decides the extent and the manner of crowding out effects. Subsidies give recipients an artificial competitive edge. Therefore, they have the potential to keep inefficient recipients alive and/or to induce a crowding out of nonsubsidized firms. In order to minimize these distortions, subsidies should be targeted at truly "good" firms (Shane, 2009).

Previous studies analyzing subsidy allocation schemes mainly focus on one single program (e.g., Aschoff, 2008). Given the coexistence of various programs, we take an aggregate view on the allocation of R&D subsidies. Does this variety of programs with different target groups translate into systematic differences between subsidized and nonsubsidized start-ups and their founders? Or does the variety of programs conceal that there is actually no overall policy focus?

These questions are addressed by this chapter's focus on the allocation of R&D subsidies to start-ups in the East German state of Thuringia. Our representative sample allows us to take an aggregate view of the allocation of R&D subsidies and thus enables us to make generalizations from single programs which often change their designs over time. In order to get unbiased results only those subsidized and nonsubsidized start-ups which are engaged in R&D are examined. Our analysis is structured as follows. Section 4.2 describes the economic rationale for the targeting of R&D subsidies. Assuming a strategy

[64] This chapter is based on Cantner and Kösters (2009a).

[65] An overview about programs that are currently available gives the online database http://www.foerderdatenbank.de/, administered by the German government.

of "picking the winner", hypotheses regarding the characteristics of subsidized firms are derived. We use data from the Thuringian Founder Study which is introduced in Section 4.3. The determinants of the receipt of R&D subsidies are examined with the help of a logistic regression (Section 4.4). Section 4.5 discusses the results and Section 4.6 concludes.

4.2 Targeting of R&D subsidies: Economic rationales and policy implementation

This section begins with the rationale for the targeting of R&D subsidies and follows up with how policy targeting can be implemented in praxis.

Economic rationales

The rationale for R&D policy programs is found in the presumed existence of neoclassical market failures (Arrow, 1962; Hall, 2002). Conversely, system failures, as discussed in neo-Schumpeterian approaches, are held responsible for an insufficient amount of innovative activity, also justifying certain policy measures (Chaminade and Edquist, 2005; Lundvall et al., 2002).

Referring to the somewhat traditional market failure approach, positive external effects resulting from innovative activity provide a first rationale for public policy intervention. A second rationale for policy intervention stems from capital market imperfections: mainly due to uninsurable risk and information asymmetries R&D projects are not likely to receive the same funding conditions as normal investment and not all R&D projects are likely to attract adequate funds from private sources.

If entrepreneurs cannot completely appropriate the returns from innovative activity and/or cannot raise the funds for R&D investments at reasonable costs, they invest in R&D at a socially suboptimal level. This implies that firms either do not invest in R&D at all or conduct projects at a smaller scale. Then, subsidies reduce the costs and uncertainty of private R&D activity and thereby aim to induce firms to undertake R&D that would otherwise be unprofitable (Wallsten, 2000). The framework for most evaluations is captured by the concept of additionality which focuses on additional R&D activity that should be stimulated by public R&D funds (Luukkonen, 2000).

Based on that reasoning, those projects should be funded, which yield high social returns (i.e. returns above the risk-adjusted opportunity costs of capital) but would not be started in the absence of subsidies, because the private returns are not expected to exceed the risk-adjusted opportunity costs of capital (Stiglitz and Wallsten, 2000). The funding of

inframarginal projects should be avoided because they are expected to be privately profitable and therefore are pursued anyway. In this case, the subsidization would just form a transfer payment (without any additionality) and would not have any allocative effect – thus constituting windfall gains.

However, the identification of the private and social returns of an R&D project requires detailed information about highly uncertain outcomes. Policymakers and program officials have to quantify private and social returns ex-ante, a monumental if not unsolvable task considering the uncertainty of R&D activities as well as the difficulties to identify and quantify diffuse spillovers (Stiglitz and Wallsten, 2000).

Another line of reasoning considers cooperative or collective innovative activities being superior to those activities performed in isolation (Edquist, 2001). Such a systemic view claims that due to the division of labor, cooperative R&D projects with other companies, customers or researchers are more promising. Systemic failures in the sense that innovators do not actively search for a cooperation partner (problem of intermediation) or are afraid of a partner's non-reciprocal behavior in knowledge exchange (problem of reciprocity) may serve an anchoring point for policy intervention. Subsidies for cooperative R&D projects would encourage the search for appropriate partners and/or dampen (or compensate for) any fear of non-reciprocity (Eickelpasch and Fritsch, 2005). Hence, R&D co-operations should be more liable to be subsidized. Here the focus is quite clearly on those marginal projects which do not get activated because of system failures.

Equivalent to the problems raised by identifying private and social outcomes of R&D projects are the challenges of identifying and quantifying systemic failures. Again, considering the uncertainty involved in R&D projects as well as measuring the exchange of knowledge spillovers, this task is not easily, if at all, being performed in praxis.

Policy implementation and "picking the winner strategy"

Facing these information problems, we argue that the actual targeting of R&D support schemes does not focus on identifying malfunctions in markets or systems or on finding marginal projects, but rather follows a strategy of "picking the winner". When first looking at established firms, evidence for a policy focus on the most promising and best-equipped firms has been found for a large German R&D project funding scheme (Aschhoff, 2008). Policymakers and program officials focus on ventures that promise to favorably contribute to employment growth and structural change.

There are four additional arguments in favor of a policy approach of "picking the winner". First, the focus of R&D funds to these presumably truly "good" firms intends to

minimize substitution effects, i.e. the crowding out of nonsubsidized competitors. Subsidies give beneficiaries an artificial competitive edge and in this way equalize ex-ante less efficient and more efficient firms. If only truly good firms receive subsidies (crowding out less efficient firms at any rate), the resulting market distortions will be minimal (Shane, 2009)[66]. Second, the strategy of picking likely winners may direct funds to particular future technologies, e.g. biotechnology (Fier and Heneric, 2005). Third, R&D activity is inherently risky (Arrow, 1962). As a result from this stochastic effect, the subsidization of R&D projects will ineluctably include failures. Public choice theory suggests that a strong political commitment is required to justify the subsidization of failed projects. Therefore, policymakers and funding authorities are induced to pick winners, i.e. to focus on projects with a high probability of success rather than funding projects with higher expected returns but a lower probability of success (Stiglitz and Wallsten, 2000). Finally, the certification of "good" projects to potential private investors might be a side-effect of a selective policy approach. Lerner (1999) argues that public funds certify the quality of their recipients and thereby attract private investors.

The suggested identification of good firms seems to be a task which can be performed rather easily in the case of already existing firms – just look at their performance in the past. However, when newly founded firms are on the policy agenda this does not work – except in the case of serial entrepreneurship. A look at a more general pattern of successful entrepreneurship is applicable here. Entrepreneurship research has identified various determinants of new venture success and thus provides guidelines for a strategy of "picking the winner" (Shane, 2009). Policymakers and funding authorities should allocate public R&D funds according to the following pre-treatment characteristics:

- *Novelty of the business idea*: The innovativeness of a start-up can be regarded as a key determinant of positive external effects, since innovative ventures commercialize knowledge and thereby contribute to diversity, increase competition, and foster economic growth (Fritsch, 2008). This is reflected by their relatively higher contribution to structural change in the long-run (Baptista and Preto, 2006). In particular, academic spin-offs which are often headed by faculty or research staff of the originating research institution provide an effective means to apply scientific research to commercial ends (Roberts, 1991; Shane, 2004).
- *Ambitions at the beginning of the first business year*: Small business managers' aspirations to expand their business activities are positively related to actual growth

[66] However, there are still distortions arising from raising taxpayer's money to finance the subsidy as well as deadweight losses arising from screening applicants.

(Wiklund and Shepherd, 2003). Similarly, Autio (2005) finds disproportional employment effects for high-expectation entrepreneurs[67]. Although these highly ambitious entrepreneurs represent only 3% to 17% of all entrepreneurs (depending on the country), they account for up to 80% of total expected jobs by all entrepreneurial activity (Autio, 2005).

- *Resource strength of the founding project*: The accumulation of knowledge as captured by founders' previous patents shows the resource-strength and the potential to innovate (Fier and Heneric, 2005; Czarnitzki et al., 2007). Additionally, the resource base of a start-up as proxied by the number of founders (single versus team start-ups) (Kamm et al., 1990; Lechler, 2001) and the size of initial capital is positively related to various performance measures (Van Praag et al., 2005).

However, a potential emphasis on probable winners might be diluted by information asymmetries and distorted incentives of policymakers, funding authorities, and applicants (Public Choice considerations). First, applicants have much better information about their projects and expectantly present their project to increase the chances of approval (adverse selection). Second, rather than pursuing the public interest, the allocation of R&D subsidies might also follow specific interests in the policy process (Hart, 2003b; Stiglitz and Wallsten, 2000). The potential to focus public funds on particular industries might trigger rent-seeking activities which might be an explanation for an ongoing focus of policymakers on the manufacturing sector (Czarnitzki and Fier, 2001). In sum, information asymmetries as well as a Public Choice perspective suggest that a policy targeting of "picking the winner" might be blurred.

[67] Autio (2005) defines high-expectation entrepreneurs as those nascent entrepreneurs who aim to employ at least 20 employees within five years' time.

4.3 Data

4.3.1 Sample

The Thuringian Founder Study

Data for this study were collected within the Thuringian Founder Study (*Thüringer Gründer Studie*), an interdisciplinary project on the success and failure of innovative start-ups in the East German state of Thuringia. The database draws from the commercial register for commercial and private companies (Handelsregister, Abteilung A/B) in Thuringia and includes 2,971 start-ups in innovative industries registered between 1994 and 2006. Innovative industries, according to ZEW classification (Grupp and Legler, 2000), comprise 'advanced technology' and 'technology-oriented services'.

The survey population consists of 4,215 founders (first registered owner-managers) who registered a new entry in the Handelsregister between 1994 and 2006. This design made it possible not only to interview founders of active companies but also founders of ventures that have failed since inception. We selected a random sample from the survey population so 3,671 founders of start-ups were contacted. Due to team start-ups this corresponds to 2,604 new ventures in innovative industries. Between January and October 2008, we conducted 639 face-to-face interviews with solo entrepreneurs or with one member of a start-up team (a response rate of about 25%). The 76 start-ups that turned out not to be genuinely new (e.g., they were a new branch or new business area of an existing company) were removed. A further 13 interviews had to be deleted due to concerns over interview quality. In order to exclude any effects of the German reunification, only start-ups with a first business year later than 1993 were considered[68]. This reduced the number of valid interviews to 450.

The structured interviews were personally conducted by the members of the research project. We were supported by student research assistants, after being trained in various sessions in December 2007. On average, an interview took one and a half hours. The interviews covered a broad set of questions regarding socio-demographic and psychological data of the founder. Moreover, we asked for founder's activities along the founding process. Economic data focused on the time before the first business year and the first three business years. Retrospective data relating to events in founder's life and to the

[68] We defined the first business year as the time when accounting started either because of obligations from the commercial register or because of first revenues. This does not necessarily correspond to the date of registration in the Handelsregister.

business history were collected using a modified version of the Life-History-Calendar (Belli et al., 2004, Caspi et al., 1996), which increases the validity of retrospective data.[69]

The sample of investigation

From the data of the Thuringian Founder Study, the majority of venture set ups in the sample (61.2%) reported having conducted R&D within the first three business years. Due to missing values for single variables and the exclusion of one outlier[70] we arrive at 243 R&D performing start-ups which constitute the sample of investigation in this chapter. Public funds in support of R&D were given to 106 firms (43.6% of all R&D performing start-ups).

Additional data

For the data on the patent stock, we accessed the database of the German patent information system (DEPATIS) provided by the German Patent and Trade Mark Office. For each interviewed start-up, we looked for patent applications where the founder(s) and/or partner(s) were named as inventors. We then calculated the sum of patent applications within the last five years before the first business year. Double counts resulting from co-patenting were eliminated.

4.3.2 Variables

The dependent variable *R&D Subsidy* describes the take-up of R&D subsidies within the first three business years. The dummy variable is coded 1 if the respective start-up received R&D subsidies and 0 otherwise. Table 4.1 shows the independent variables, their definitions and hypothesized directions:

[69] The Life-History-Calendar is a method developed by psychologists and sociologists and is based on the principles of the autobiographic memory. This means that – in a first step – we asked interviewees about the timing of well-known events (e.g. marriage, birth of children). In a second step, these events served as anchors for less well represented events (e.g. first interest in entrepreneurship).

[70] We have to discard one outlier which has a patent stock of 148 patents, almost the triple amount of the start-up with the second highest patent stock.

Novelty **(+)**	The *novelty of the business idea* refers to the scope of the newness of the business idea. Possible answers were no novelty (0), regional or local (1), supra-regional but national (2), European (3) or global novelty (4).
Academic Spin-off **(+)**	*Academic spin-offs* were coded as a dummy variable with 1 denoting start-ups where the business idea evolved from previous employment at a university or research institute (academic spin-off) and with 0 otherwise.
Goals **(+)**	Four items build up the variable *goals* at the beginning of the first business year. Interviewees were given four contradictory pairs with a 5 level scale in-between. They had to classify their goals at the beginning of the first business year given the following pairs: working entirely cost-covering vs. to realize much profit (1); to earn one's living vs. to become rich (2); to be a small provider vs. to become market leader (3): to generate constant revenues vs. to generate constantly rising revenues (4). The mean of these answers was build for each observation.
Team **(+)**	*Team* start-ups were defined as new ventures where more than one person was actively involved in the founding process and was intended to become an owner of the company. We code a dummy variable with 0 in the case of a single founder, and with 1 in the case of a team start-up.
Patent stock **(+)**	The *patent stock* is the sum of patent applications of founders and partners within the last five years before venture set-up.
Initial Capital **(+)**	The *amount of initial capital* at the beginning of the first business year was asked for with the help of the following table: 1,000 EUR or less (1), more than 1,000 to 10,000 EUR (2), more than 10,000 to 50,000 EUR (3), more than 50,000 to 100,000 EUR (4), more than 100,000 to 250,000 EUR (5), more than 250,000 to 500,000 EUR (6), more than 500,000 EUR (7).
Cooperative R&D	If R&D was performed in co-operation with others within the first three business years, this dummy variable is coded as 1, otherwise 0.
Year 1994-1997 Year 1998-2001 Year 2002-2006	Dummy variables that capture the time of business start, i.e. the first business year of the company when accounting started either because of obligations from the commercial register or because of first revenues.
	Industry-dummies (NACE, 1 digit):
Nace 2……:::::....	Chemical industry, metalworking industry, engineering
Nace 3……:::::....	Electrical engineering, fine mechanics and optics
Nace 7……:::::……	Information and Communication Technology, R&D, Services
Nace x……:::::……	Miscellaneous
Product	The value for the dummy variable *Product* is 1 if the start-up offered a product in the first three business years and the value is 0 in the case of service companies.

Table 4.1: Definition and hypothesized direction of independent variables

Descriptive statistics of each variable and the correlation matrix can be found in Table 4.2.

	M	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) R&D Subsidy	0.436	0.497	-															
(2) Novelty	1.794	1.688	0.279 ***	-														
(3) Academic Spin-off	0.173	0.379	0.256 ***	0.294 ***	-													
(4) Goals	3.221	0.907	0.110 *	0.311 ***	0.058	-												
(5) Team	0.691	0.463	0.157 **	0.095	0.258 ***	0.059	-											
(6) Patent Stock	1.407	4.555	0.165 **	0.322 ***	0.231 ***	0.153 **	0.086	-										
(7) Initial Capital	3.420	1.389	0.105	0.143 **	0.047	0.125 *	0.084	0.149 **	-									
(8) Cooperative R&D	0.473	0.500	0.346 ***	0.243 ***	0.221 ***	0.026	0.116 *	0.199 ***	0.059	-								
(9) Year 1994-1997	0.391	0.489	0.027	-0.081	-0.188 ***	-0.118 *	-0.085	-0.013	-0.065	0.051	-							
(10) Year 1998-2001	0.337	0.474	0.092	-0.042	0.226 ***	0.024	0.062	0.098	0.038	0.021	-0.572 ***	-						
(11) Year 2002-2006	0.272	0.446	-0.127 **	0.134 **	-0.034	0.104	0.027	-0.090	0.031	-0.079	-0.489 ***	-0.436 ***	-					
(12) Nace 2	0.263	0.441	0.039	-0.095	-0.150 **	0.048	0.015	0.065	0.160 **	0.107 *	0.134 **	-0.091	0.050	-				
(13) Nace 3	0.272	0.446	0.097	0.245 ***	0.088	0.134 **	0.027	0.157 **	0.086	0.181 ***	0.099	0.014	-0.123 *	-0.365 ***	-			
(14) Nace 7	0.374	0.485	-0.063	-0.050	0.119 *	-0.109 *	0.002	-0.116 *	-0.257 ***	-0.171 ***	-0.184 ***	0.077	0.120 *	-0.463 ***	-0.473 ***	-		
(15) Nace x	0.091	0.288	-0.104	-0.150 **	-0.106 *	-0.098	-0.069	-0.148 **	0.055	-0.155 **	-0.047	-0.013	0.065	-0.189 ***	-0.193 ***	-0.244 ***	-	
(16) Product	0.337	0.474	0.197 ***	0.196 ***	-0.050	0.126 **	0.025	0.118 *	0.260 ***	0.143 **	0.053	-0.068	0.014	0.186 ***	0.327 ***	-0.408 ***	-0.104	-
Note: * p<0.1; ** p<0.05; *** p<0.01; N=243																		

Table 4.2: Descriptive statistics and intercorrelations

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Novelty	0.290 *** (0.093)	0.279 *** (0.096)	0.292 *** (0.093)	0.305 *** (0.094)	0.283 *** (0.093)	0.255 *** (0.096)
Academic Spin-off	1.220 *** (0.416)	1.222 *** (0.416)	1.079 ** (0.427)	1.285 *** (0.425)	1.220 *** (0.417)	0.985 ** (0.435)
Goals		0.068 (0.165)				
Team			0.482 (0.326)			
Patent Stock				-0.033 (0.033)		
Initial Capital					0.088 (0.109)	
Cooperative R&D						1.169 *** (0.305)
Year 1994-1997	0.818 ** (0.376)	0.836 ** (0.379)	0.878 ** (0.382)	0.796 ** (0.378)	0.833 ** (0.378)	0.756 * (0.387)
Year 1998-2001	0.851 ** (0.387)	0.853 ** (0.387)	0.882 ** (0.391)	0.847 ** (0.387)	0.851 ** (0.387)	0.833 ** (0.396)
Nace 2	0.343 (0.576)	0.329 (0.577)	0.312 (0.582)	0.378 (0.579)	0.331 (0.577)	0.018 (0.605)
Nace 3	0.008 (0.596)	-0.007 (0.596)	-0.006 (0.600)	0.041 (0.597)	0.015 (0.597)	-0.327 (0.630)
Nace 7	0.170 (0.559)	0.175 (0.559)	0.172 (0.565)	0.180 (0.560)	0.214 (0.563)	0.115 (0.583)
Product	0.825 ** (0.335)	0.825 ** (0.335)	0.829 ** (0.337)	0.831 ** (0.336)	0.774 ** (0.341)	0.848 ** (0.347)
Constant	-2.053 *** (0.575)	-2.256 *** (0.759)	-2.399 *** (0.636)	-2.061 *** (0.575)	-2.345 *** (0.683)	-2.296 *** (0.601)
N	243	243	243	243	243	243
LR chi2	42.478	42.648	44.706	43.438	43.131	57.479
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Mc Fadden´s R^2	0.128	0.128	0.134	0.130	0.130	0.173
Cox-Snell R^2	0.160	0.161	0.168	0.164	0.163	0.211
Nagelkerke R^2	0.215	0.216	0.225	0.219	0.218	0.282

Dependent variable: R&D Subsidy which describes whether start-up takes up R&D subsidies within the first three business years

Table 4.3: Logistic regressions

4.4 Results

The results of logistic regressions are displayed in Table 4.3. We run six different models which contain the same set of controls and the same two core independent variables *Novelty* and *Academic Spin-off*, but differ with respect to the other independent variables. In all six models we control for the period the new venture was founded, whether the start-up offered a service or a product, and for the industry. The time dummies are always significant, indicating a decline in the R&D related subsidization of start-ups since 2002. Furthermore, the significantly positive dummy variable *Product* points to a lower likelihood of service companies to receive R&D subsidies.[71] The industry dummies never show a significant coefficient, indicating that there are no sectors having been more likely to receive a R&D subsidy.

Looking at all six models, the novelty of the business idea (*Novelty*) as well as the dummy variable *Academic Spin-off* turn out to have both a positive impact on the probability of receiving R&D subsidies. Their impact is significant at the 5% and 1% level throughout. As their coefficients change only slightly between the six models, we consider this a confirmation of the robustness of our results. Our results thus indicate that R&D programs allocate funds in favor of start-ups with more innovative/novel ideas and of academic spin-offs. The focus on more innovative start-ups is likely to be driven by the expectation that they show a comparatively higher competitiveness and in consequence success. Having generated a global novelty instead of a local novelty makes a start-up less vulnerable to competitors. This, however, may be also an argument for expected higher private returns and accordingly less need to be subsidized. Therefore, we find an indication for a "picking the winner strategy".

The case of a higher funding probability of academic spin-offs could be interpreted in the same way since basic new insights there show a high degree of novelty. Additionally, one has to take into account that supporting academic spin-offs ranks high on the policy agenda devoted to generating more economic value out of basic research in academia (Shane, 2004). However, by arguing that the step to found a new venture is much more difficult to do for a scientist in academia compared to someone having gained business experience elsewhere already, academic spin-offs can be interpreted as marginal projects – they would not come into existence without appropriate subsidization and an interpretation as a "picking the winner strategy" would not apply.

[71] This focus of policymakers and economic research on the manufacturing sector has been also pointed out by Czarnitzki and Fier (2001).

Starting with model 1 as the base model, the previously described variables only, we add the independent variable *Goal* in model 2. The variable turns out to be insignificant, indicating no impact of the founders' ambitions on the probability of being subsidized. This implies that the allocation of funds does not follow the expectations and goals of the applying entrepreneurs but looks for more hard facts. Those hard facts could be seen in the resource strength of the founding project, our third criterion. Models 3, 4 and 5 test the impact of the start-ups' resource strength as denoted by the variables *Team*, *Patent Stock* or *Initial Capital*. None of the characteristics of being a *Team* start-up, the extent of the *Patent Stock,* or the amount of *Initial Capital* exerts a significant impact on the probability of receiving R&D subsidies. Furthermore, likelihood-ratio tests do not indicate any higher explanatory power of the extended models 2 to 4 in comparison with the base model (model 1). This again does not sustain our "picking the winner" hypothesis. However, the resource strength of the founding project will be partly captured by the variable *Academic Spin-off*, since academic spin-offs are mainly launched by highly qualified teams and feature a high patent stock (Shane, 2004).

In a last step, the variable *Cooperative R&D* is added (model 6). This variable has a highly significant positive impact on the probability of receiving R&D subsidies. A likelihood-ratio-test reveals that model 6 has a significant higher explanatory power than the base model. A founding project's access to external resources, as indicated by its engagement in cooperative R&D, goes along with a higher probability to receive R&D support. This can be interpreted on the one hand in terms of expecting a higher probability of success, sustaining our hypothesis. On the other hand, it would not be sustained if firm founding based on collaborative R&D indicated comparatively higher returns. If collaborative R&D was essential for a new venture, but not pursued without a subsidy, the project was merely marginal; again not validating our "picking the winner" hypothesis but rather suggesting subsidies' potential to build winners. However, the variable *Cooperative R&D* might be subject to interdependencies with the dependent variable. A considerable number of R&D support programs target cooperative R&D. Hence, cooperative R&D might be a result of the subsidy scheme, because the program criteria encourage potential applicants to engage in R&D co-operations.

4.5 Discussion

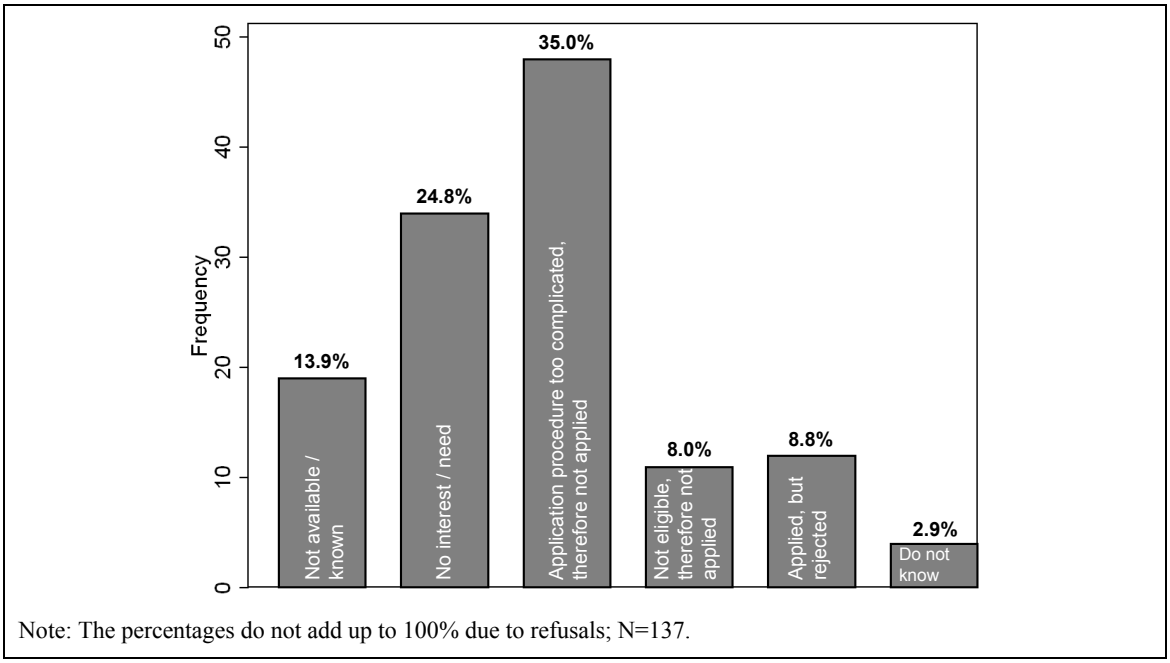
When interpreting our ambiguous support for a policy strategy of "picking the winner", we have to start by analyzing by whom the selectivity is exerted and then what this selectivity implies for policy effectiveness.

Sources of selectivity

Interpreting the positively significant coefficients of collaborative R&D, of academic spin-offs, and of start-ups selling products versus services, one has to be aware that several R&D programs exclusively focus on those criteria and consequently fund only respective projects. Since our sample contains enough new ventures not satisfying one or all of these criteria that do not receive policy support, the coefficients of collaborative R&D, of academic spin-offs, and of start-ups selling products absolutely must show up significantly positive. Hence, our positive coefficient covers two conceptually different cases of selectivity, the first being that the bias is imposed prior to announcing the tender and a second instance where the bias shows up during the selection of projects by the committees. Since both mechanisms are exerted by policymakers and/or program officials, they are interchangeably termed as administrative (Storey, 2000), agency (Wallsten, 2000) or committee selection (Storey, 2003). More tendentiously, Bassi (1984) speaks of "cream-skimming" by program administrators. However, we cannot verify whether there are well-defined allocation rules behind particular programs, because we lack data on the basis of individual funding schemes.

Moreover, not only do policymakers and program officials select beneficiaries of R&D support programs but also founders and their start-ups might self-select into the programs (Storey, 2000). Since subsidization reduces the costs of R&D, we assume that everybody would apply whose expected benefits from the R&D subsidy exceed the costs of applying. Figure 4.1 shows the answers of nonsubsidized founders regarding the reasons why they did not make use of subsidies. The first two categories, "not available/known" and "no interest/need" (representing 38.7% of nonsubsidized founders), can be subsumed as self selection of founders and might be explained by founders' (self-perceived) costs of applying for public R&D funds (e.g. time and effort spent on getting informed about funding schemes and application procedures). The other categories can be more or less regarded as committee selection. The highest fraction of nonsubsidized founders (35.0%) reported that overly complicated application procedures prevented them from applying. This category, to some extent, blurs with the fourth category ("not eligible, therefore not applied") which both characterize different stages of dropping out along the information

and application process. The applications of 8.8% of nonsubsidized founders had been rejected, indicating clear-cut committee selection. The reasons for non-subsidization might be biased, because we only asked founders of nonsubsidized start-ups, who still conducted R&D. However, we do not have data about start-ups which applied unsuccessfully and, therefore, did not conduct R&D at all – the marginal projects.



Note: The percentages do not add up to 100% due to refusals; N=137.

Figure 4.1: Reasons for non-subsidization

Policy effectiveness and efficiency

The analyzed allocation of R&D subsidies does not assert whether they could effectively promote additional R&D activity. Even if there was a clear focus on "picking the winner", this approach does not promise to be the most effective and efficient. Although a selective subsidization of likely winners might minimize substitution effects, it runs the risk of enormous windfall gains: Likely winners will probably not only yield high social returns but also high private returns, rendering public policy intervention obsolete (Santarelli and Vivarelli, 2007). Furthermore, selective policy approaches coincide with deadweight losses resulting from screening and selecting procedures of eligible applicants (Parker, 2007). However, the subsidy allocation process can also mobilize co-operative innovative activity and enable learning effects for policymakers when it is organized as a contest of initiatives for self-organized co-operation in R&D (Eickelpasch and Fritsch, 2005).

The differences between subsidized and nonsubsidized firms analyzed in this article constitute a selection bias. This selection bias is taken into account when matching

procedures are applied to evaluate policy effectiveness[72]. These methods then facilitate causal analyses on the effectiveness and efficiency of support schemes which consider performance indicators like revenue, employment and survival. However, these effectiveness analyses focus primarily on private returns. They neglect the original rationale of the subsidization of private R&D, i.e. positive external effects. Realizing positive external effects effectively and efficiently requires the identification of projects that are privately unprofitable but socially beneficial, the very starting point of this chapter. Policy strategies like "picking the winner" are simply approaches to circumvent the monumental information requirements.

4.6 Conclusions

This chapter has drawn on new survey evidence to verify whether R&D subsidies are allocated according to a "picking the winner" approach. We argued that policymakers and program officials pursue a "picking the winner" strategy to circumvent fundamental information problems in identifying projects which yield high social returns but low private returns and thus would not be realized (to the full extent) in the absence of subsidies. As hypothesized, we find that a high degree of novelty and being an academic spin-off increases the likelihood of receiving R&D subsidies. However, other ex-ante indicators of likely winners like founder's prior ambitions, being a team start-up, previous patent experience and the amount of initial capital do not increase the likelihood of receiving R&D subsidies.

These ambiguous results point to difficulties in precise policy targeting which, in turn, fundamentally question the massive subsidization of private R&D[73]. Widespread subsidization lacks exclusivity and thus does not allow for the certification of good projects (as suggested by Lerner (1999)). Moreover, it absorbs the demand for R&D funds and, therefore, runs the risk of hampering the development of a market for private R&D funding.

Our analysis is based on aggregate data on the receipt of R&D subsidies, i.e. we lack information on the take-up of particular schemes and we do not have information on the amount of the subsidy. Therefore, we necessarily mix up selectivity *within* and *between*

[72] Examining the same data set with propensity score matching in Chapter 5, we find a high impact of R&D subsidies on start-up's employment growth and patent output within the first three business years.

[73] Additional R&D funds of 6bn Euro between 2006 and 2009 have been announced by the promotional initiative "High-Tech Strategy for Germany" (BMBF, 2006). Fostering R&D and technology-oriented start-ups is a stated aim of this initiative. The high public subsidization can be also seen in our sample: 43.6% of all R&D performing start-ups receive public R&D funds.

single policy schemes and cannot distinguish whether selectivity is exerted by any differential extent of subsidization. Although these data limitations are a clear shortcoming of this study, the overall subsidy allocation should still be consistent with the pursuit of enabling R&D activity which would not be carried out in the absence of subsidies. Our aggregate data on public R&D funding thus offers unique insights into the overall subsidy allocation for a random sample. Nevertheless, it is the dispersed and continuously changing subsidy environment that impedes more precise policy insights.

5. R&D subsidies to start-ups – Effective drivers of patent activity and employment growth?[74]

5.1. Introduction

Newborn firms as well as small and medium sized companies contribute crucially to technological change through research and development (R&D) and innovation (Acs and Audretsch, 1990; Audretsch, 2006). This has led to a rise in policy programs targeted at the R&D of (nascent) entrepreneurs and their newborn firms all over the world (Lerner, 1999). Fostering R&D and technology-oriented start-ups is a stated aim of promotional initiatives such as the "High-Tech Strategy for Germany", which announced additional R&D funds of 6bn Euro between 2006 and 2009 (BMBF, 2006). Especially in East Germany, R&D support schemes focus on small and medium enterprises as well as start-ups (Deutscher Bundestag, 2005).

Rather traditionally, the presumed existence of market failure provides a rationale for public R&D subsidies. The presence of R&D spillovers – which have been studied, for example, by Griliches (1992) and Jaffe (1996) – is one argument in favor of public intervention, since the limited appropriability of returns from R&D induces firms to invest below the social optimum in R&D. A second argument in favor of subsidizing R&D is based on information imperfections on the part of financial institutions. Sunk and firm-specific investment, low collateral value, and the high uncertainty of returns impact the financing conditions for R&D projects. This holds especially true for newborn firms which lack the necessary size to cross-subsidize R&D projects and to diversify the risks from innovative activity. In addition, they lack a track record to signal their creditworthiness to private investors. However, their R&D activity might still be socially beneficial by inducing knowledge spillovers as well as by challenging incumbents and thus ensuring competitive markets. Based on these three failures, public intervention could be justified and public expenditures may help overcome a lack of private investment in uncertain R&D projects and at the same time may certify the high quality of the R&D projects for other potential investors (Lerner, 1999).

However, the underlying reasons for policy intervention are not beyond dispute. The arguments opposing R&D subsidies and entrepreneurship policies are traditionally based on windfall gains and market distortions. First, windfall gains arise when companies would have performed the R&D project irrespective of public subsidies. Wallsten (2000) points out that efficient R&D subsidy should only be given to R&D projects that have

[74] This chapter is based on Cantner and Kösters (2009b).

positive net social benefits but negative net profits for the innovating firm. Hence, R&D subsidies should complement rather than crowd out private R&D investments. Second, market distortions occur because public support schemes equalize ex-ante less efficient and more efficient firms and in this way distort market selection as well as the learning processes of founders. This means that subsidization is an 'artificial seedbed' for less efficient firms, which would have been induced to leave the market if they had not received assistance (Santarelli and Vivarelli, 2006; Stam et al., 2009). This (potential) crowding out of nonsubsidized firms makes some authors oppose entrepreneurship policy schemes altogether (Parker, 2007).

Notwithstanding the theoretical arguments against public intervention, there is public money invested in R&D schemes. To ensure that taxpayer's money is spent effectively and efficiently, as well as to guide further policy-making, they have to be evaluated. Although policy evaluation is commonplace and part of most policy initiatives, Lerner (1999, p. 285) notes that "public subsidization of small firms has attracted virtually no scrutiny". Most evaluations only monitor the take-up of schemes and recipients' opinions, especially their views of the differences made by the assistance, and not the effectiveness and efficiency of the intervention. In fact, this mere monitoring of R&D schemes is not able to reveal any causal effects.

The present study attempts to overcome this gap and examines the effectiveness of R&D support schemes available to start-ups in innovative industries in the East German state of Thuringia. Doing so, we take an aggregate view and analyze the effectiveness of the subsidy environment – instead of a specific subsidy program – which young technology-oriented firms face. This perspective is especially promising when considering the great variety of different and often overlapping policy programs targeted at R&D[75]. Therefore, we evaluate a mixture of different but similar programs all available to Thuringian start-ups engaged in R&D within the first three business years. Our analysis is based on a random sample of innovative start-ups in innovative industries and focuses on those conducting R&D. We thus select those start-ups from which academics and policymakers expect the highest social returns accruing from innovation. Two different performance measures are examined, each capturing private returns of (subsidized) R&D activities: employment growth and innovation output (i.e. patent applications). We first argue that effective subsidies must lead to increasing R&D activity, which manifests in

[75] Bundestag (2005) and Belitz (2001) provide insights into the volatile subsidy environment that East German firms face with regard to public R&D funds.

employment growth. Second, subsidies that foster the R&D activity of start-ups should also lead to higher innovation output measured by patent applications.

Identifying the impact of R&D support schemes ideally would require a counterfactual analysis. As this is not possible, one compares assisted firms with an appropriate control group of other firms (Storey, 2000). The set-up of a control group must consider that the allocation of public R&D funds cannot be assumed to be arbitrary. On the one hand, a strategy of policymakers might be to grant public means to promising ventures ("picking the winner"). On the other hand, public R&D funds might back firms with less promising R&D projects. If those sources of potential selection are ignored, the evaluation of the effects of public assistance will be biased.

In order to overcome that possible selection bias in our policy evaluation, we apply propensity score matching (Rosenbaum and Rubin, 1983). The idea of this methodology is to assign to each assisted start-up a "statistical twin", i.e. a start-up that has not been subsidized but that nevertheless has a similar probability of receiving public R&D funds. In this way, we create an adequate control group to estimate the causal effects of public R&D programs on employment growth and patent applications of subsidized firms.

The remainder of the chapter is structured as follows. Previous studies on the effectiveness of R&D support schemes are discussed in Section 5.2. Section 5.3 presents the evaluation framework. The assumptions and the procedure of the potential outcome approach are then applied to our founder dataset in Section 5.4. Section 5.5 presents the results and their robustness. Finally, Section 5.6 concludes.

5.2 Literature review

The rise of R&D support schemes is accompanied by a growing literature on the effectiveness of R&D-subsidies. These studies differ with regard to their data bases and the level of aggregation, ranging from country-, industry- and firm-level analyses to experimental studies.

The straightforward approach in the typical econometric literature is regressing some measure of private R&D on public R&D to determine complementarity or substitutability of public R&D subsidies[76]. Here, the effectiveness of R&D subsidies is related to firm-internal decision processes: Public R&D-funds might be either directed to projects that would have been undertaken anyway, leading to full or partial crowding out (substitution) of private investment, or they might stimulate additional private R&D effort,

[76] David et al. (2000) and Klette et al. (2000) provide extensive surveys.

implying additionality or complementarity of R&D subsidies. For instance, González et al. (2005) find that Spanish manufacturing subsidies increase total R&D expenditure by 8%, resulting both from inducing firms to conduct R&D at all as well as from fostering the R&D activity of firms that would have been engaged in R&D anyway. Analyzing firms in East Germany, Czarnitzki (2001) finds that the average innovation intensity, i.e. the ratio between innovation expenses to sales, of subsidized firms adds up to 10% whereas the innovation intensity of matched nonsubsidized firms is only 5%. David et al. (2000) conclude that the evidence on the effectiveness of publicly funded R&D schemes is mixed. This can be attributed to methodological differences as well as to the fact that most studies concentrate on the evaluation of one specific program. As these schemes differ in, e.g., program design, extent of financial support and regional scope, different results from evaluations are to be expected.

Alternatively, an increasing number of studies suggest a more indirect approach to the evaluation of the effectiveness of R&D schemes (David et al., 2000). These studies estimate the impact of R&D schemes on particular outcome variables, such as employment, patent applications and sales. In the absence of indicators for the social returns of subsidized R&D projects, these outcome variables indicate private returns and tend to capture effects beyond that level. On this basis, if subsidized firms reallocate public R&D funds to other means than publicly intended (namely additional R&D activities), subsidized firms and their nonsubsidized counterparts should not differ with respect to both the inputs to the R&D activity (e.g., measured by (R&D) employment growth) and the output of the R&D process (e.g., measured by patent applications).

Analyzing the effectiveness of R&D subsidies with regard to employment is justified for primarily three reasons: First, most R&D support programs focus on supporting R&D labor cost and other running costs, accounting for the fact that most R&D expenditure in small firms are spent for the salaries of scientists and engineers (Himmelberg and Petersen, 1994). Hence, additional R&D activity should be best captured by R&D-related employment growth. Second, grants might not only impact employment directly related to the subsidized R&D project; if R&D subsidies increase commercial opportunities, firms might employ additional personnel to expand production (Wallsten, 2000). Third, employment effects are regarded as a proxy for the social returns of R&D support schemes. High employment growth characterizes innovative high tech start-ups, which spur structural change and account for overall positive employment effects (Fritsch, 2008).

The Small Business Innovation Research (SBIR) scheme, a US program targeted at R&D projects of small firms, has been evaluated with regard to its employment effects (Lerner (1999) and Wallsten (2000)). Lerner compares SBIR awardees with firms of similar size and industry as well as with firms of similar size from the same region that have not received SBIR funds. He finds that firms having obtained SBIR funds in the period 1983-1985 grew significantly faster with respect to employment and sales between 1985 and 1995 (however, only in regions with substantial venture capital). Wallsten (2000) adopts a somewhat stronger experimental design and explicitly addresses the problem of endogeneity – the receipt of subsidies might induce employment growth, but at the same time high-performance firms might be also more likely to receive funds. Wallsten pursues an instrumental variable approach to address this selection bias and comes to a less favorable conclusion regarding the program's effectiveness. He shows that firms with more employees and patents are more likely to receive SBIR funds. Wallsten points out that the average recipient exhibits annual sales of more than $4 million and employs more than 40 people and is as a result far from being the stereotypical entrepreneur. Whereas firms with more employees are more likely to receive subsidies, these, in turn, do not affect employment. Moreover, Wallsten's results suggest that public R&D funds lead to a crowding out of private investments in R&D. Studies explicitly distinguishing between the effects of the subsidy on aggregate employment and on aggregate expenditure suggest that subsidies affect wages of R&D personnel, since labor supply in R&D is strongly inelastic (Goolsbee, 1998; Wolff and Reinthaler, 2008).

Other studies examine the effectiveness of R&D subsidies looking at patent applications of subsidized and nonsubsidized firms. Patents are a widely used measure for innovation output due to their availability and standardization. Furthermore, they have been found to be in close temporal proximity to actual R&D activity (Hall et al., 1986). However, the shortcomings of patent statistics, namely their heterogeneous – and often inconsiderable – economic value and varying propensities to patent across industries, are well known (see Griliches (1990) for a survey). Czarnitzki and Licht (2006) analyze the additionality of R&D subsidies with respect to innovation input (measured as private R&D expenditure) and innovation output (proxied by patent applications) for German firms in the mid to late 1990s. In a first step, they find that R&D grants positively impact private R&D investment. In a second step, they investigate whether additional R&D investments induced by subsidies improve innovation results. Subsidized firms in East Germany turn out to have both a significantly higher likelihood of having applied for a patent and a

higher number of patent applications. Hence, for East Germany, there is no evidence that government-induced R&D is less productive than purely privately financed R&D activity.

Czarnitzki et al. (2007) analyze the impact of R&D subsidies and collaboration on the patenting activity for a sample of Finnish and Western German firms in the mid to late 1990s. They interpret R&D collaboration and subsidies as heterogeneous and conduct econometric matching to account for selection bias. Looking at firms not engaged in R&D cooperation, subsidies stimulate only the patent output of Finnish firms. (Western) German firms receiving R&D subsidies for individual research do not show a higher patent output (measured by a dummy which indicates if a firm has filed at least one patent). However, collaborative R&D activity (both subsidized and nonsubsidized) stimulates patent activity as well as R&D intensity (R&D expenditure / sales) in both countries.

The studies reviewed so far look at the effectiveness of R&D support schemes at the level of established firms. There are only a few studies assessing the effectiveness of R&D schemes at the level of newborn firms. Koga (2005) analyzes panel data of Japanese high-technology firms that were all founded after 1989. He finds that the receipt of public R&D funds impacts positively on the (natural logarithm of) company-funded R&D. This complementary relationship between public and private R&D investment holds with and without considering a time lag between the receipt of R&D subsidies and private R&D investment one year later. However, when the dataset is split and only start-ups younger than six years are considered, R&D subsidies no longer show positive effects on private R&D investment. Koga's results suggest that newborn firms do not have a strong incentive to conduct additional R&D, as they are confined by their initial funds. Instead, mature firms and growth-oriented young firms are more likely to allocate public R&D funds to additional R&D. Lerner (1999) offers a similar explanation when he asks for more studies to analyze the long-run effects of R&D grants. He puts forward the proposition that small high-technology firms are often organized around one key researcher. For these small and/or young firms, it may not be possible to accelerate the project's progress by employing more researchers or technicians. Conversely, Lach (2002) finds that R&D subsidies only stimulate private R&D expenditure in small firms. R&D subsidies might enable small firms to conduct additional R&D projects which could not be realized before because of the comparatively higher costs of raising capital for small firms.

R&D conducting start-ups in innovative industries form a subset of start-ups which are expected to contribute most to structural change and long-run economic growth (Acs, 2008). On the one hand, this selection of well-equipped research-oriented start-ups concludes likely winners that have been found to outperform non-innovative entries

(Almus et al., 1999). This obviously questions the necessity of subsidization suggesting that subsidies will constitute deadweight losses. On the other hand, these start-ups will be particularly affected by lacking appropriability of returns from R&D and potential credit market failure (Stiglitz and Wallsten, 2000). R&D subsidies might thus induce additional R&D activity. Based on the literature just reviewed, our analysis focuses on young, R&D conducting start-up firms in innovative industries and takes the indirect approach of evaluating the effectiveness of R&D support schemes. The outcome variables considered are employment growth and patent applications.

5.3 The evaluation framework

Evaluating the effectiveness of R&D support schemes for start-up firms requires a methodological approach allowing us to compare the performance of a firm with and without having received the support. Since the latter, counterfactual outcome, is not available, a special method has been developed to tackle this issue, this being the application of so-called matching models.

The potential outcome approach

When estimating causal effects with observational data, the problem arises that individual treatment effects are impossible to determine since we cannot observe the subsidized firm's performance if it had not been subsidized, and vice versa. We follow Roy (1951) and Rubin (1974) in their formalization of the potential outcome approach. We are interested in the *average treatment effect for the treated* (ATT), i.e. the expected differential economic performance of subsidized firms which can be attributed to the receipt of public subsidies. The treatment indicator, D, equals 1 if the firm receives subsidies; the indicator is coded 0 otherwise. The outcome for each firm is then defined as Y^1 if a firm's R&D is subsidized; a firm's outcome is denoted Y^0 in the case of no subsidies. With E as the expectation operator, the ATT can thus be defined as

$$\text{(ATT)} \qquad \mathrm{E}(Y^1 - Y^0 \mid D = 1) = \mathrm{E}(Y^1 \mid D = 1) - \mathrm{E}(Y^0 \mid D = 1) \qquad (1)$$

A firm can only be subsidized or nonsubsidized, so only one of the outcomes is observed. The outcome that cannot be observed is termed the counterfactual outcome. With non-experimental data, this counterfactual outcome $\mathrm{E}(Y^0 \mid D = 1)$ cannot be substituted with $\mathrm{E}(Y^0 \mid D = 0)$, because subsidized firms are supposed to be a selective group that would show different performance even in the absence of any subsidization.

In order to approach the counterfactual outcome, the selection of firms into treatment is assumed to be based on observables. The *conditional independence assumption* (CIA) states that, given a set of observable exogenous (not affected by the treatment) characteristics, X, potential outcomes are independent of the treatment assignment:

(CIA) $$D \perp (Y^1, Y^0) \,\big|\, X \quad \forall\, X \qquad (2)$$

To put it another way, if one can fully control for observable differences in characteristics between the subsidized and nonsubsidized firms, the outcome that would result in the absence of any subsidies is the same in both cases. Consequently, if the CIA holds, the matching process can be compared to creating an experimental dataset, in that, conditional on observed characteristics, the selection process is random. Obviously, the CIA is a strong assumption. Since we employ a rich dataset which should contain comprehensive information on the determinants of both subsidization and outcome, we are confident in maintaining such a strong assumption.

Implicit in this notation is the *stable unit treatment value assumption* (SUTVA) which states that the subsidization does not impact on any firms other than those that are explicitly treated and whose outcome is denoted Y^1 (Rubin, 1991). In our context, this implies that R&D subsidies do not impact on nonsubsidized firms by market effects or knowledge spillovers. Thus, SUTVA rules out general equilibrium effects of R&D subsidies. However, interaction effects can both over- and underestimate the ATT. On the one hand, the ATT is overestimated when the employment growth of subsidized firms is realized at the expense of nonsubsidized firms. On the other hand, nonsubsidized firms might profit from knowledge spillovers generated in subsidized firms, which leads to an underestimation of the subsidy's impact. Since these mechanisms of action are difficult to identify empirically, we follow the SUTVA and ignore general equilibrium effects. However, we indirectly account for different interaction effects by examining employment growth and patent output as outcome variables.

Propensity Score Matching

Subsidized and nonsubsidized firms are matched on the basis of important, exogenous characteristics, X. Increasing the number of observable covariates constitutes a practical constraint, because the chances of finding a control unit decrease the greater the number of characteristics used in the match. Rosenbaum and Rubin (1983) propose the use of propensity score matching to solve this problem of dimensionality. The basic idea is not to match on covariates directly, but to match on a function of the covariates X which

describes the propensity to receive treatment, i.e. $P(D=1|X)=P(X)$. This predicted probability of group membership $P(X)$ – i.e., subsidization vs. non-subsidization – is usually obtained from logistic regression. Rosenbaum and Rubin (1983) show that matching on a single index, which reflects the probability of participation, could result in consistent estimates of the treatment effect in the same way as matching on all covariates. The CIA based on the propensity score is then given by

(CIA based on propensity score) $$D \perp (Y^1, Y^0) \,\big|\, P(X) \quad \forall\, X \qquad (3)$$

Propensity score matching, however, cannot entirely solve the problem of having no appropriate matches, because propensity scores might strongly differ between subsidized and nonsubsidized firms. The additional assumption of common support ensures that the propensity scores of subsidized and nonsubsidized firms overlap, i.e. persons with the same X values have a positive probability of being either subsidized or nonsubsidized. More technically, observations are only regarded if their propensity score values show a positive density within the group of subsidized as well as nonsubsidized firms. The region of common support should be substantial. Failing this, a considerable error may be introduced. This might happen, if only the worst cases from the nonsubsidized "comparison" group are compared with only the best cases of all subsidized firms.

Matching algorithms

There are various matching algorithms which all contrast the outcome of a treated firm $i \in I_1$ with a weighted average of the outcome of (some) control group observations, $j \in I_0$. Following the notation of Caliendo (2006), the average treatment effect for the treated (ATT) can be stated as

$$ATT = \frac{1}{N_1} \sum_{i \in I_1} [Y_i^1 - \sum_{j \in I_0} W_{N_0}(i,j)\, Y_j^0] \qquad (4)$$

with Y_i^1 denoting the outcome of the treated firm i and Y_j^0 the outcome of untreated firms j. N_1 (N_0) is the number of observations in the treatment group I_1 (control group I_0). The outcome of i is contrasted with the average weighted outcome of the control group, where the weights are given by $W_{N_0}(i,j)$. Usually, the weights the weighting function assigns to the untreated firms are higher the closer the untreated firms and the treated firm are with respect to the observed characteristics. The total weight of all controls adds up to one for each treated firm, i.e. $\sum_{j \in I_0} W_{N_0}(i,j) = 1 \;\forall\, i$.

The matching algorithms differ in terms of the construction of the weighting functions and the definition of potential "neighborhoods" which restrict the number of observations that serve as a comparison unit. An overview of different matching algorithms can be found in Heckman et al. (1998) as well as in Smith and Todd (2005). Smith (2000) points out that all matching estimators asymptotically yield the same results, since they all approach only exact matches as the sample size grows. However, the results from different matching algorithms can differ in small samples, pointing to a trade-off between quality and quantity of the matches. A matching algorithm yielding few but good matches will lead to biased estimates, whereas a matching procedure with many but poor matches yields higher variance. Thus, the choice of the matching algorithm depends on the available data structure.

In our evaluation, we apply kernel matching. This matching estimator uses all units in the control group to construct a match for each treated firm. Therefore, it promises to exploit our data best, since the sample is relatively small and there are almost as many subsidized firms as nonsubsidized control firms (see Section 5.4.1). The major advantage of kernel matching is the lower variance, since more information for the construction of the counterfactual is used. However, the use of more information is at risk to include bad matches. Kernel matching employs the following weigths,

$$W_{N_0}(i,j) = \frac{G_{ij}}{\sum_{k \in I_0} G_{ik}} \tag{5}$$

with G_{ik} denoting a kernel function $G[(P_i - P_k)/h]$. The implementation of kernel matching involves two choices: the choice of the kernel function G_{ik} as well as the choice of the bandwidth parameter h. If a symmetric, nonnegative, unimodal kernel is employed, higher weights are attached to observations close in terms of the propensity score P. DiNardo and Tobias (2001) note that the kernel employed is relatively unimportant in practice, but the choice of the bandwidth parameter matters. The bandwidth parameter h determines a trade-off between a small variance and an unbiased estimate of the true underlying density function (DiNardo and Tobias, 2001). On the one hand, the higher the bandwidth parameter, the smoother is the estimated density function, which leads to a better fit and a decreasing variance between the estimated and the true underlying density function. On the other hand, a high bandwidth parameter risks biased estimates, because underlying features of the true density function might be smoothed away. There are two methods of bandwidth selection: the method of cross-validation and the plug-in-method (Baumgartner and Caliendo, 2008). We employ the latter and follow Silverman's (1986)

frequently used rule-of-thumb to determine the bandwidth h and thus balance bias and variance. $h = 0.9 \cdot A \cdot n^{-1/5}$ is the optimal bandwidth for a Gaussian (normal) kernel. Herein n denotes the number of observations and the term $A = \min(standard\ deviation, \frac{interquartile\ range}{1.34})$ accounts for the distribution of the propensity score.

5.4. Empirical analysis

After introducing our database and the employed variables (Section 5.4.1), we estimate the propensity score and look for the region of common support (Section 5.4.2). In Section 5.4.3, Kernel matching is performed and the matching quality is assessed.

5.4.1 The data

Data for this study were collected within the Thuringian Founder Study *(Thüringer Gründer Studie)*, which is an interdisciplinary project on the success and failure of innovative start-ups in the eastern German state of Thuringia. The survey population consists of 4,215 founders (first registered owner-managers) who registered 2,971 start-ups in innovative industries in the Thuringian *Handelsregister* between 1994 and 2006. Innovative industries, according to ZEW classification (Grupp and Legler, 2000), comprise 'advanced technology' and 'technology-oriented services'. This design made it possible to interview not only founders of active companies but also founders of ventures that had failed. From the survey population, we selected a random sample so that 3,671 founders of start-ups were contacted. Due to team ventures, this corresponds to 2,604 start-ups in innovative industries. Between January and October 2008, we conducted 639 face-to-face interviews with solo entrepreneurs or with one member of a start-up team (a response rate of about 25%). The 71 start-ups that turned out not to be genuinely new (e.g. they were a new branch or new business area of an existing company) were removed. A further 17 interviews had to be deleted due to concerns over interview quality. In order to exclude any effects of the German reunification, only start-ups with a first business year later than 1993 were considered[77]. This reduced the number of valid interviews to 450.

[77] We defined the first business year as the time when accounting started either because of obligations from the commercial register or because of first revenues. This does not necessarily correspond to the date of registration in the Handelsregister.

The structured interviews were conducted by the members of the research project. We were supported by student research assistants who were trained in various sessions in December 2007. On average, an interview took one and a half hours. The interviews covered a broad set of questions regarding socio-demographic and psychological data of the founder. Moreover, we asked for founder's activities along the founding process. Economic data focused on the time before the first business year and the first three business years. Retrospective data relating to events in the founder's life and to the business history were collected using a modified version of the Life-History-Calendar (Belli et al., 2004), which increases the validity of retrospective data.[78]

The majority of venture set ups in the sample, i.e. 273 start-ups (61.2%), reported having conducted R&D within the first three business years. These R&D performing start-ups constitute the unit of investigation in this article. Public funds in support of R&D were given to 116 firms (42.5% of all R&D performing start-ups) anytime within the first three business years.[79] Similarly to Czarnitzki (2001) we neither have information about the specific subsidy scheme nor on the amount of subsidization. We do know, however, that R&D subsidies comprise mainly wage subsidies for R&D personnel, project-specific funding and start-up incentives (Belitz et al., 2001). Figure 5.1 shows the first business year of all interviewed start-ups and pictures the shares of those start-ups that performed R&D as well as received R&D subsidies.

[78] The Life-History-Calendar is a method developed by psychologists and sociologists and is based on the principles of the autobiographic memory. This means that – in a first step – we asked interviewees about the timing of well-known events (e.g., marriage, birth of children). In a second step, these events served as anchors for less well represented events (e.g., first interest in entrepreneurship).

[79] Due to missing values for specific variables, 28 observations had to be dropped. Six of these start-ups did not survive the first three business years. Furthermore, two outliers were discarded which showed an employment growth of 5500% and 158 patent applications within the first four business years, respectively. We thus ended with 243 common observations, analyzed with regard to both outcome variables.

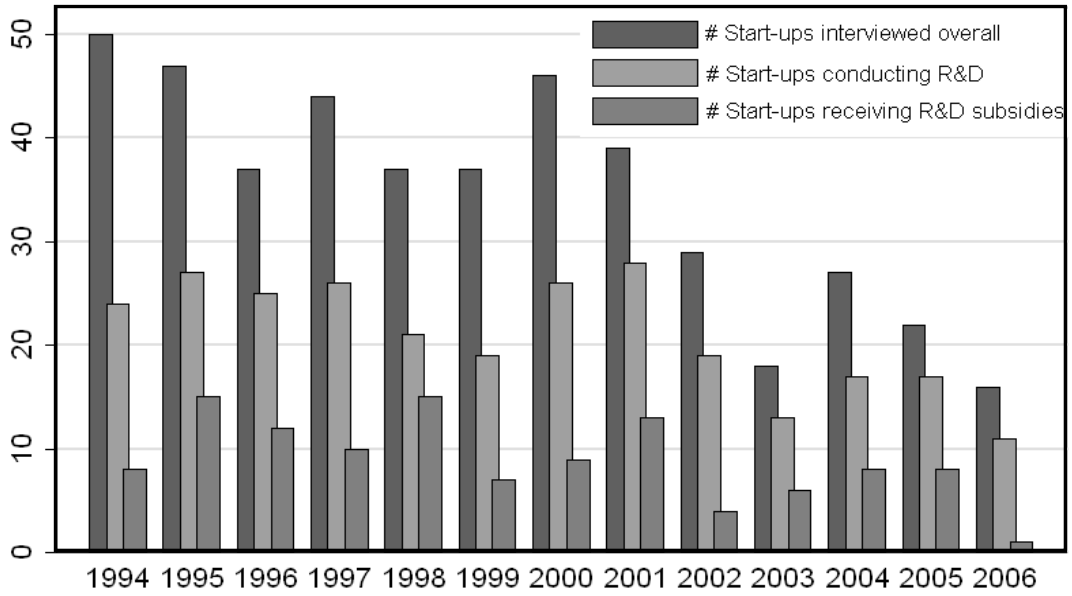


Figure 5.1: First business year of interviewed start-ups (overall), R&D-performing start-ups and those start-ups that received R&D subsidies

Variables

We examine the effectiveness of R&D subsidies on employment growth and patent output, which are captured by the following variables:

Founders were asked about the employment trend of their start-ups. Employment growth within the first three business years is then defined as

$$Employment\ growth_{3\ business\ years} = \frac{Employment_{3rd\ year} - Employment_{1st\ year}}{Employment_{1st\ year}}$$

Here *Employment* comprises different kind of employment relationships, such as the working time of founders, active partners, conventional employees, hired labor and trainees. The measure is normalized on full-time positions, thereby considering part-time jobs.

For the patent output, we accessed the database of the German patent information system (DEPATIS) provided by the German Patent and Trade Mark Office. For each interviewed start-up, we looked for patent applications where the founder(s) and/or partner(s) were named as inventors. Furthermore, we looked for patents which were applied for directly by the start-ups in our sample. This procedure captures potential patents of employees working for the start-ups. We then calculated the sum of patent applications in the years before the first business year as well as the sum of patent applications in each business year. Double counts resulting from co-patenting were eliminated. Our outcome variable *Patent output* covers the patent applications that can be attributed to the start-up's R&D activity within the first three years.

Patents have been found to be applied in close temporal proximity to actual R&D activity (Hall et al., 1986). Scherer (1984) provides survey evidence from the U.S. and the former West Germany suggesting a lag of nine months between the initial conception of an invention and the application for a patent. Therefore, we allow for a time lag of one year to capture patent applications that are still related to R&D activity of the first three business years. In short, the patent outcome can be depicted as follows:

$Patent\ output_{3\ business\ years} = P_{Founders} \cup P_{Partners} \cup P_{Start-ups}$ with

$P_{Founders} = \sum_{t=1}^{4} Patents\ \ of\ Founders_{\ t}$, $P_{Partners} = \sum_{t=1}^{4} Patents\ of\ Partners_{t}$ and

$P_{Start-ups} = \sum_{t=1}^{4} Patents\ of\ Start-ups_{\ t}$.

For the matching approach, our dataset allows us to base the conditional independence assumption on a broad set of variables which characterize the start-up before the first business year. We describe these variables in Table 5.1.

Novelty	The *Novelty* of the business idea refers to the scope of the newness of the business idea. Five categories were given: no novelty (0), regional or local (1), supra-regional but national (2), European (3) and global novelty (4).
Academic spin-off	*Academic spin-offs* are start-ups where the business idea evolved from previous employment at a university or research institute. We code a start-up by a dummy variable with 1 in the case of an academic spin-off and with 0 otherwise.
Product	The value for the dummy variable *Product* is 1 if the start-up offered a product in the first three business years and the value is 0 in the case of service companies.
Team	*Team* start-ups were defined as venture set-ups where more than one person was actively involved in the founding process and was intended to become an owner of the company. We code a dummy variable with 0 in the case of a single founder, and with 1 in the case of a team start-up).
Patent stock	The patent stock is the sum of patent applications of founders and partners within five years before venture set-up. The variable is built up in the same way as the variable "patent output".
Target market	The scope of the *Target market* ranges from 0 to 3 – 0 denoting a regional or local target market, 1 denoting a supra-regional but national target market, 2 denoting a European market, and 3 indicating a global market.
Year 1994-1997 Year 1998-2001 Year 2002-2006	Dummy variables that capture the time of business start, i.e. the first business year of the company when accounting started either because of obligations from the commercial register or because of first revenues.
	Industry-dummies (NACE, 1 digit):
Nace 2……..	Chemical industry, metalworking industry, engineering
Nace 3……..	Electrical engineering, fine mechanics and optics
Nace 7……..	Information and Communication Technology, R&D, Services
Nace x……	Miscellaneous

Table 5.1: Variables describing pre-treatment characteristics of the start-ups

The correlation matrix is given in Table 5.2. Mean differences in the pre-treatment characteristics between subsidized and nonsubsidized firms are depicted in the first column block of Table 5.3.

	Employ-ment growth	Patent output	Take-up of R&D subsidies	Academic spin-off	Novelty	Patent stock	Product	Target market	Team	Year 1994-1997	Year 1998-2001	Year 2002-2006	Nace 2	Nace 3	Nace 7	Nace x
Employment growth	-															
Patent output	0.1169 *	-														
Take-up of R&D subsidies	0.1932 **	0.2155 ***	-													
Academic spin-off	0.1907 **	0.2725 ***	0.2268 ***	-												
Novelty	0.1278 **	0.3153 ***	0.2821 ***	0.2685 ***	-											
Patent stock	0.1243 *	0.5534 ***	0.1878 **	0.2835 ***	0.3510 ***	-										
Product	0.0639	0.2539 ***	0.1995 **	-0.0509	0.1965 **	0.1020	-									
Target market	0.1579 **	0.1415 **	0.0853	0.0765	0.2178 ***	0.1385 **	0.3151 ***	-								
Team	0.1373 **	0.0653	0.1404 **	0.2386 ***	0.0855	0.0914	0.0173	0.0677	-							
Year 1994-1997	-0.0113	0.0352	0.0172	-0.2193 *	-0.0990	-0.0053	0.0392	-0.1462 *	-0.0846	-						
Year 1998-2001	-0.0484	0.0118	0.0966	0.2500 *	-0.0162	0.0719	-0.0856	0.0149	0.0846	-0.5777 *	-					
Year 2002-2006	0.0647	-0.0513	-0.1233 *	-0.0298	0.1259 **	-0.0718	0.0495	0.1441 **	0.0012	-0.4717 ***	-0.4472 ***	-				
Nace 2	0.0419	-0.0287	0.0404	-0.1422 **	-0.0944	0.0377	0.2023 **	0.1442 **	0.0196	0.1182 *	-0.0971	-0.0246	-			
Nace 3	0.0694	0.2789 ***	0.1110 *	0.1027	0.2434 ***	0.1815 **	0.3119 ***	0.1253 *	0.0152	0.0919	0.0068	-0.1081 *	-0.3727 ***	-		
Nace 7	-0.0921	-0.1435 **	-0.0817	0.0960	-0.0634	-0.1120 *	-0.4089 ***	-0.1412 **	-0.0098	-0.1707 **	0.0983	0.0809	-0.4739 ***	-0.4546 ***	-	
Nace x	-0.0175	-0.1423 *	-0.0965	-0.0964	-0.1195 *	-0.1495 *	-0.1087 *	-0.1810 *	-0.0376	-0.0393	-0.0236	0.0685	-0.1967 ***	-0.1887 **	-0.2399 ***	-
Note: * p<0.1; ** p<0.05; *** p<0.01																

Table 5.2: Correlation matrix; N=243

	Before Matching		Employment growth After Matching		Patent output After Matching	
	Mean of…		Mean of matched…		Mean of matched…	
	… subsidized start-ups N=103	… non-subsidized start-ups (potential controls) N=140	… subsidized start-ups N=103	… non-subsidized start-ups (actual controls) N=139	… subsidized start-ups N=93	… non-subsidized start-ups (actual controls) N=140
Academic spin-off	**0.2524**	**0.0857**	0.2524	0.2382	0.1720	0.1572
Novelty	**2.2913**	**1.3286**	2.2913	2.2488	2.129	2.0703
Patent stock	1.6796	1.2143	1.6796	1.9601	1.5699	1.7291
Product	**0.4563**	**0.2643**	**0.4563**	**0.2549**	0.3979	0.4178
Target market	1.3884	1.2357	1.3883	1.3307	1.3656	1.489
Team	**0.7670**	**0.6357**	0.7670	0.7794	0.7527	0.6867
Year 1994-1997	0.3883	0.3714	0.3884	0.3095	0.4194	0.3364
Year 1998-2001	0.4078	0.3143	0.4078	0.3276	0.3763	0.2980
Year 2002-2006	**0.2039**	**0.3143**	**0.2039**	**0.3629**	**0.2043**	**0.3656**
Nace 2	0.3010	0.2643	0.3010	0.2320	0.3333	0.2891
Nace 3	**0.3204**	**0.2214**	0.3204	0.2512	0.2473	0.2982
Nace 7	0.3204	0.4000	0.3204	0.4270	0.3548	0.3406
Nace x	0.0583	0.1143	0.0583	0.0898	0.0645	0.0721
Employment growth	**1.3101**	**0.8271**	**1.3101**	**0.7894**	**1.2829**	**0.8580**
Patent output	**3.5728**	**0.7571**	**3.5728**	**1.3373**	**2.7312**	**0.9632**
Propensity score (employment growth)	**0.4892**	**0.3758**	0.4892	0.4827	-	-
Propensity score (patent output)	**0.5031**	**0.3655**	-	-	0.4664	0.4585

Please note: The balancing of the variables is depicted after kernel matching with the optimal bandwidth. Bold numbers indicate significant different means between observation from subsidized start-ups and nonsubsidized start-ups before and after matching in a two-sided t-test (5%-significance level).

Table 5.3: Group differences between subsidized and nonsubsidized start-ups before and after matching

5.4.2 Estimation of the propensity score and common support

Table 5.3 shows that subsidized and nonsubsidized firms exhibit significant differences regarding, e.g., the novelty of their business idea, the kind of business (product vs. service) and the origin of the business idea (*Academic spin-off*). Subsidized start-ups are significantly more often team start-ups. This indicates that self selection into R&D support schemes and committee selection of program officials make the group of subsidized ventures a selective one. As a consequence, if the distinguishing characteristics of subsidized and nonsubsidized firms have an impact on the outcome variable (employment growth and patent output, respectively), a direct comparison between the two groups will be biased. A priori the direction of the bias is unknown.

Consequently, those variables should be included in the estimation of the propensity score which influence both the receipt of R&D subsidies as well as the respective outcome variable. We estimate a propensity score model for each outcome variable. Therefore, we look for variables which correlate with the receipt of R&D subsidies and simultaneously

with the respective success measure (employment growth and patent output) (Table 5.2). Moreover, we conduct multivariate analyses to identify other distinguishing characteristics between subsidized and nonsubsidized firms which have an impact at the same time on employment growth and patenting, respectively. In the following, the variable choice for each propensity score model is explained.

Employment growth. Table 5.2 shows that the variables *Academic spin-off*, *Novelty*, *Patent stock* and *Team* are all correlated with both the *Take-up of R&D subsidies* as well as *Employment growth*. A high degree of *Novelty* (which is also reflected in many prior patent applications), being an *Academic spin-off* and a *Team* start-up are all characteristics of innovative start-ups.[80] At the same time, the positive correlation of these variables with the receipt of R&D subsidies points to a policy strategy of "picking the winner".[81]

The provision of products instead of services (*Product*) is correlated with the *Take-up of R&D subsidies* but not correlated with *Employment growth*. Apart from univariate statistics, we therefore run ordinary least squares regressions to find evidence whether *Product*, particular founding years and the industry influence employment growth. These regressions cannot reveal further determinants of employment growth.

Patent output. The variables *Academic spin-off*, *Novelty*, *Patent stock* and *Product* are all correlated with both *Take-up of R&D subsidies* as well as with *Patent output* (Table 5.2). Additionally, operating in electrical engineering, fine mechanics and optics (*Nace 3*) is positively correlated with the receipt of R&D subsidies and patent output. The patent applications, which are attributed to a start-up in each year, are highly correlated with one another, indicating path dependency of patent activity. We balance subsidized and nonsubsidized firms on the basis of previous patent experience by introducing the number of patent applications in the last five years before founding (measured by the variable *Patent stock*) in the estimation of the propensity score. Since negative binomial regression models cannot display any further determinants of patent output, which also differentiate between subsidized and nonsubsidized firms, we estimate the propensity score with the variables *Academic spin-off*, *Novelty*, *Patent stock*, *Product* and the industry dummies.[82]

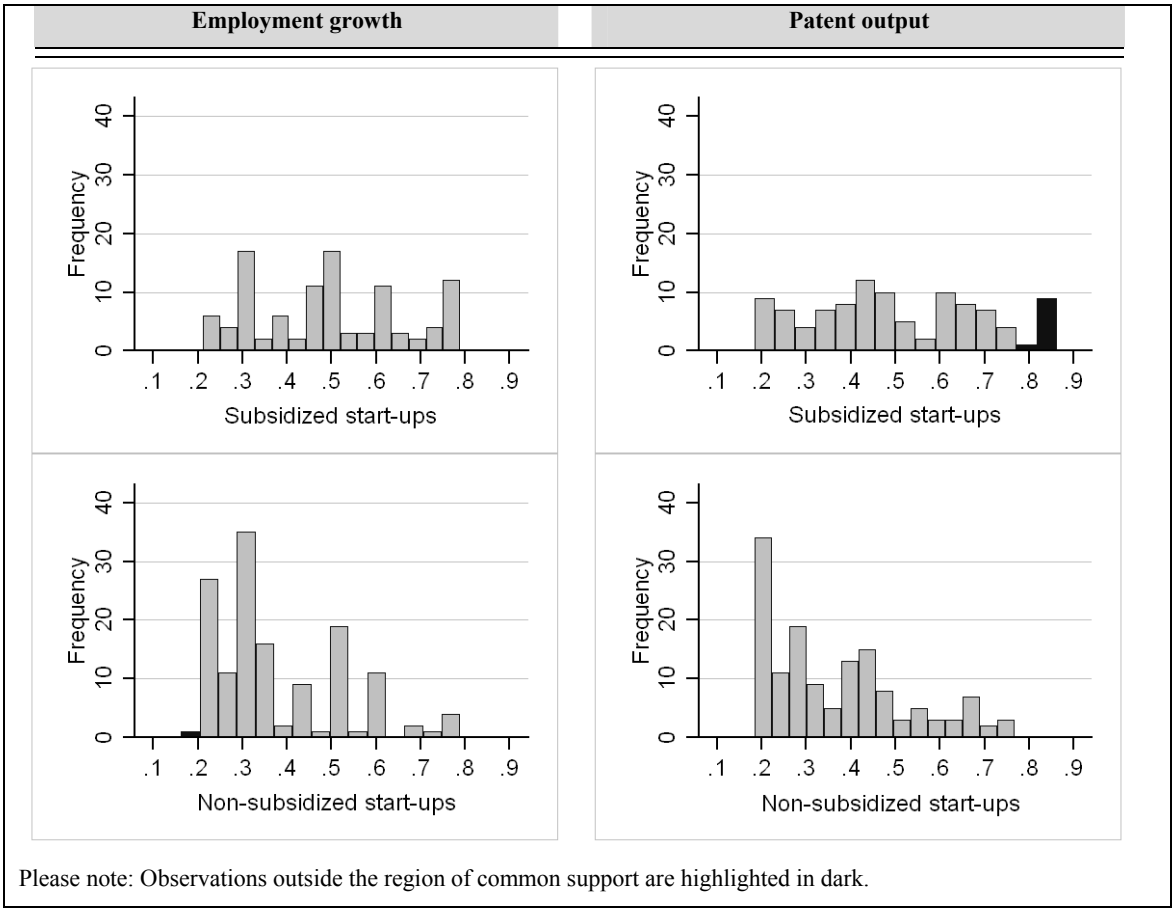
[80] Our data is thus in line with Almus et al. (1999), who analyze the employment growth of start-ups in East Germany. They find that innovative start-ups grow on average faster than non-innovative start-ups.
[81] For an in-depth discussion of the allocation of R&D subsidies see Chapter 4, or alternatively, Cantner and Kösters (2009a).
[82] The results from both multivariate analyses can be obtained from the authors.

The propensity to take up public R&D assistance is estimated with a logit model (Table 5.4). Following the discussion above, the selected variables for each of the two models are regressed on the binary dependent variable *Take-up of R&D subsidies*. Since we are primarily interested in prediction and data reduction, redundancy and collinearity are of little account (Smith, 1997). However, this limits the interpretation of the coefficients, which are not further discussed here.

	Employment growth	**Patent output**
Dependent variable: Take-up of R&D subsidies		
Academic spin-off	0.8986** (0.4121)	1.2087*** (0.4205)
Novelty	0.3186*** (0.0865)	0.2796*** (0.0899)
Patent stock	-0.0275 (0.0309)	-0.0322 (0.0314)
Product		0.7050** (0.3288)
Team	0.4301 (0.3115)	
Nace 2		0.4871 (0.5638)
Nace 3		0.3004 (0.5828)
Nace 7		0.1841 (0.5513)
Constant	-1.2822*** (0.2957)	-1.4898*** (0.5059)
N	243	243
LR chi2 (k)	(4) 28.48	(7) 35.02
Prob > LR	0.0000	0.0000
McFadden's R2	0. 0860	0.1057
Note: * p<0.1; ** p<0.05; *** p<0.01; standard errors in parentheses		

Table 5.4: Estimation of the propensity score

The common support condition ensures that any set of characteristics of subsidized firms (captured by the propensity score) can also be observed for nonsubsidized ones. Especially for kernel matching, the condition of common support is important. Otherwise, nonsubsidized firms that lack a potential matching partner are inevitably taken to construct the counterfactual. We determine the region of common support with a minimum-maximum comparison of the distribution of the propensity score. Figure 5.2 depicts the distribution of the propensity score for subsidized and nonsubsidized firms. The region of common support is given by the overlap and requires discarding one nonsubsidized (10 subsidized observations) from the analysis of employment growth (patent output).



Please note: Observations outside the region of common support are highlighted in dark.

Figure 5.2: Distribution of the propensity score – separately for the analysis of employment growth (left column) and the analysis of the patent output (right column)

5.4.3 Matching and matching quality

Calculating the optimal bandwidth for our sample, we arrive at $h = 0.0500$ for employment growth and $h = 0.0502$ for patent output[83]. We thus perform kernel matching employing a Gaussian kernel with a bandwidth of 0.0500 and 0.0502, respectively.[84]

The second and third column block of Table 5.3 show the characteristics of our control groups after matching. After matching, the nonsubsidized and subsidized matched firms do not exhibit any significant differences regarding any characteristics which are assumed to have an impact on both, the receipt of R&D subsidies as well as on employment growth and patent output. Although industry dummies are not included in the

[83] The calculation is as follows. For the analysis of employment growth, $A = \min(0.166685, \frac{0.5259101 - 0.2990019}{1.34}) = 0.166685$ is inserted in $h = 0.9 \cdot A \cdot 242^{-1/5}$. Hence, the optimal bandwidth is $h = 0.0500$. Analogous to the previous calculation, the optimal bandwidth for the analysis of the patent output is derived by estimating $A = \min(0.1658171, \frac{0.5289473 - 0.2638597}{1.34}) = 0.11658171$ and $h = 0.9 \cdot A \cdot 233^{-1/5} = 0.0502$.

[84] Estimations are done using the psmatch2 Stata ado package by Leuven and Sianesi (2003) and the att Stata ado package by Becker and Ichino (2002).

propensity score estimation for the study of employment growth, the matching procedure manages to equalize subsidized and nonsubsidized firms in terms of their industry classification.

As recommended by Sianesi (2004), we re-estimate the propensity scores on the matched samples to compare the pseudo-R^2s before and after matching. The pseudo-R^2 tells how well the variables that were included in the estimation of the propensity score explain the receipt of R&D subsidies. Before matching, the pseudo-R^2 should be high, and after matching fairly low. Moreover, a likelihood-ratio test of the joint insignificance of all the regressors before and after matching is performed. As required, the tests are rejected before but not rejected after matching.

5.5 Results and their robustness

The average treatment effect on the treated (ATT) (Table 5.5) is the difference between the mean outcome of subsidized firms and matched nonsubsidized firms. We use bootstrapping (200 replications) to calculate the standard error of the matching estimator.[85] The employment growth of subsidized start-ups exhibits an ATT of 0.5207, i.e. the difference between the mean employment growth of subsidized firms (=1.3101) and matched nonsubsidized firms (=0.7894). In other words, R&D subsidies lead to an increase in employment growth of about 66%. The ATT turns out to be significant at the 0.01 significance level. Looking at patent applications, we note that subsidized firms show a more than 2.8 times higher patent output compared to their nonsubsidized matched counterparts. This corresponds to an ATT of 1.7680, which is significant at the 0.05 level.

We employ other matching algorithms to estimate the sensitivity of the results on the employment of the kernel matching estimator[86]. Table 5.5 shows that alternative bandwidth parameters for kernel matching, k-nearest neighbor matching, as well as radius matching[87] yield qualitatively similar results. The estimates for the increase in employment growth range between 56% and 85%[88]. The patent output of subsidized start-ups is about 2.6 to 3.3 times higher. Our kernel estimates with the optimal bandwidth fit quite well in

[85] Although a distribution theory for the cross-sectional and difference-in-difference kernel and local linear matching is derived in Heckman et al. (1998), standard errors for matching estimators are in practice generated using bootstrap resampling methods. The use of bootstrapping is backed by Abadie and Imbens (2008), who suggest that the standard bootstrap can be applied to assess the variability of kernel or local linear matching estimators. However, they show that standard bootstrap resampling methods are not valid for assessing the variability of nearest neighbor estimators.

[86] See Caliendo (2006) for an overview of these matching algorithms.

[87] Radius matching means that a subsidized start-up is matched to all nonsubsidized firms within the caliper. The caliper is defined symmetrically and restricts the propensity score distance between the subsidized start-ups and the nonsubsidized control units.

[88] We do not consider the estimate from radius matching with caliper size 0.01 here, since it excludes 10 subsidized observations and is only significant at the 0.1 significance level.

these ranges of estimates. Again, we check the matching quality analogous to the proceeding for kernel matching with the optimal bandwidth. The distribution of the covariates after matching, the pseudo-R^2 from logit estimation and the p-value of the likelihood-ratio test indicate a good matching quality for all these estimations.

	Matching algorithm	Mean outcome of matched		ATT	S.E.	# Observations	
		…subsidized start-ups	…non-subsidized start-ups			Sub-sidized	Non-subsidized
Employment growth	**Kernel**						
	Optimal bandwidth (=0.0500)	1.3101	0.7894	0.5207***	0.1892	103	139
	Bandwidth 0.02	1.3101	0.7983	0.5118**	0.2039	103	139
	Bandwidth 0.04	1.3101	0.7843	0.5258***	0.1728	103	139
	Bandwidth 0.06	1.3101	0.7971	0.5130***	0.1906	103	139
	Bandwidth 0.08	1.3101	0.8132	0.4969***	0.1898	103	139
	Bandwidth 0.10	1.3101	0.8244	0.4857**	0.2106	103	139
	K-NN						
	2 NN	1.3101	0.8220	0.4881	0.3178	103	139
	5 NN	1.3101	0.7066	0.6035**	0.2463	103	139
	10 NN	1.3101	0.7521	0.5580**	0.2358	103	139
	Radius						
	Caliper 0.01	1.2909	0.8544	0.4365*	0.2277	93	139
	Caliper 0.03	1.3022	0.8363	0.4660**	0.2158	102	139
	Caliper 0.10	1.3101	0.7711	0.5390**	0.2087	103	139
Patent output	**Kernel**						
	Optimal bandwidth (=0.0502)	2.7312	0.9632	1.7680**	0.8583	93	140
	Bandwidth 0.02	2.7312	0.8890	1.8421**	0.8321	93	140
	Bandwidth 0.04	2.7312	0.9474	1.7838**	0.7900	93	140
	Bandwidth 0.06	2.7312	0.9757	1.7555**	0.8628	93	140
	Bandwidth 0.08	2.7312	0.9849	1.7462**	0.8326	93	140
	Bandwidth 0.10	2.7312	0.9726	1.7585**	0.8101	93	140
	K-NN						
	2 NN	2.7312	0.7527	1.9785**	0.9115	93	140
	5 NN	2.7312	0.8882	1.8430**	0.8198	93	140
	10 NN	2.7312	0.8688	1.8624**	0.8541	93	140
	Radius						
	Caliper 0.01	2.5955	0.7903	1.8052**	0.8396	89	140
	Caliper 0.03	2.7312	0.8237	1.9075**	0.8600	93	140
	Caliper 0.10	2.7312	1.0201	1.7110**	0.8409	93	140
Note: * p<0.1; ** p<0.05; *** p<0.01							

Table 5.5: Overview of results obtained by different matching algorithms

Matching relies on strong untestable assumptions, particularly the conditional independence assumption. The validity of the conditional independence assumption relies crucially on the possibility to compare subsidized and nonsubsidized firms on the basis of pre-treatment characteristics. Given our rich dataset, which concludes personal data of the founder and the founder team as well as characteristics of the start-up and the business idea, it is plausible to assume that the outcomes and the allocation of R&D subsidies are independent, conditional on observed attributes. Heckman et al. (1997) point out that matching methods substantially reduce biases when, first, all information is collected with

the same questionnaire for both the subsidized and nonsubsidized firms and, second, these are drawn from the same random sample (which is supported by the experimental evidence of Michalopoulos et al. (2004)). Both requisites are fulfilled in our dataset. Moreover, the sample is considerably homogenous, since we only consider genuinely new start-ups in innovative industries in the Free State of Thuringia that were actually engaged in R&D.

Ten subsidized start-ups lie outside the region of common support (Figure 5.2) and were thus excluded from the analysis of the patent output. For them, there are no potential matching partners, i.e. start-ups with similar pre-treatment characteristics that are not subsidized. Table 5.6 shows that these 10 subsidized start-ups outside the common support form a special group, even in the group of subsidized start-ups. They are different because they are all academic spin-offs that offer products in the field of electrical engineering, fine mechanics and optics (*Nace 3*). Compared to matched subsidized start-ups, they differ significantly with regard to patent output, number of patents before founding and novelty of the business idea. They were significantly more often set up between 1998 and 2001. The outlier we had to exclude in the very beginning of the analysis (see footnote 79) follows the same pattern. It is another academic spin-off offering a product that constitutes a global novelty.

	Mean of subsidized firms outside common support (N=10)	**Mean of subsidized firms inside common support (N=93)**
Employment growth (3 business years)	1.5633	1.2828
Patent output (4 business years)	**11.4**	**2.7312**
Academic spin-off	**1.0**	**0.1720**
Novelty	**3.8**	**2.1290**
Patent stock	2.7	1.5699
Product	**1.0**	**0.3978**
Target market	1.6	1.3656
Team	0.9	0.7527
Year 1994-1997	**0.1**	**0.4194**
Year 1998-2001	**0.7**	**0.3763**
Year 2002-2006	0.2	0.2043
Nace 2	**0.0**	**0.3333**
Nace 3	**1.0**	**0.2473**
Nace 7	**0.0**	**0.3548**
Nace x	0.0	0.0571
Please note: Bold numbers indicate significant different means between subsidized firms inside and outside the region of common support (two-sided t-test, 5% significance level)		

Table 5.6: Characteristics of subsidized firms – inside and outside the region of common support

Our results are also backed by the self-report of windfall gains of the respective founders. We asked each founder of a start-up with subsidized R&D activity, “Would you

have been engaged in R&D anyway?". Only 19.2% answered "yes, readily", 47.5% returned "yes, perhaps or on a reduced scale" and the remaining third (32.3%) said "no". The latter two answer categories point to the additionality of R&D subsidies.

5.6 Conclusions

High-tech and high-growth start-ups take a pivotal role in innovation and entrepreneurship policies. Investigating the effectiveness of appropriate policy programs, our analysis provides evidence for the additionality of public R&D subsidies to research-based start-ups in innovative industries. Public R&D subsidies account for an employment growth 66% greater than without such intervention. Furthermore, subsidized start-ups have a 2.8 times higher patent output than their nonsubsidized matched counterparts. These estimates take account of selection bias, which distinguishes ex-ante subsidized from nonsubsidized firms. Our results are thus in line with Czarnitzki (2001) as well as Czarnitzki and Licht (2006), who also find additionality of public R&D schemes in East Germany. However, our analysis focuses on a subset of highly innovative start-ups and thus suggests that newborn firms are capable of conducting additional R&D when they obtain public funds. R&D subsidies allow them to increase their R&D activity both in terms of additional employment and heightened patent applications. So our results conflict with the presumption that the research in start-ups cannot be scaled up since it is organized around a key researcher (or fixed research team, respectively) with a preassigned project scope.

Policy initiatives regularly focus on academic spin-offs, supposedly very effective in transferring knowledge from university or research institutes to industrial applications. This focus on academic spin-offs and its success can be nicely observed in our data. We had to exclude ten subsidized academic spin-offs from our analysis of the patent output – they all developed products and were outstanding in terms of the novelty of their business idea, so that we could not find any nonsubsidized counterparts in the matching procedure. Hence, the observed funding of academic spin-offs can be regarded as policy success, since highly innovative start-ups are expected to offer the highest social benefits. However, these observations only stand out when the impact of subsidies on patent output is regarded. Their employment growth does not differ from other subsidized start-ups. This points to the early development of the spin-offs with respect to the marketability of their products.

Qualifying our result, we put forward a couple of limitations, which in turn point to future research opportunities. First, the quality of the patent applications which form the outcome variable patent output has not been considered. The patent quality determines crucially the social returns from the R&D activity. A lower patent quality in subsidized

firms would put the higher quantity of patent applications in perspective. Public funds might pay the expenses for the patent applications of subsidized firms, so that they might be induced to file applications for low-value patents. Subsidized firms might also file for patents strategically, since patents serve as a justification to funding authorities. However, these are just presumptions which need empirical scrutiny.

Second, we define the receipt of R&D subsidies as a dummy variable, which thus accounts for heterogeneous intensity of public support. This limits our estimations to overall qualitative results. Although our approach of taking an aggregate view on the subsidy environment has its merits when looking at the almost bewildering range of funding schemes, a more detailed look at the design of support programs is needed for more precise policy recommendations. Especially, one has to account for likely changes in program design that might have occurred between 1994 and 2006 (see Belitz et al., 2001).

Third, we focus on those start-ups that conduct R&D within the first three business years. While this restriction allows us to match subsidized and nonsubsidized start-ups in a very homogeneous sample, it neglects the potential impact of R&D subsidies in inducing firms to conduct R&D at all. Furthermore, it limits our findings to an innovative research-based subset of start-ups.

Fourth, the most general limitation to our analysis is probably the SUTVA and the restriction to short-term private returns. However, we analyze two outcome variables in different stages of the innovation process, which makes us confident that we can tentatively infer from the additional R&D effort (proxied by employment growth) to additionally generated knowledge (captured by patents) and finally to social benefits reached by knowledge spillovers and market effects. Moreover, the neglect of interactions between subsidized and nonsubsidized firms and a missing proxy for social returns, although in line with the concurrent literature, should motivate further research.

In view of our result suggesting a high and positive impact of R&D policy schemes on start-up performance, the effective selectivity of these schemes requires a more fundamental question about R&D subsidies to start-ups. The economic rationale for R&D subsidies is to facilitate R&D projects that are privately not profitable, but yield at the same time social returns in excess of the opportunity cost of capital. However, the identification of social benefits should be as difficult for policy makers and program officials as for evaluation studies such as this one. In addition to that, Lerner (1999) points to public choice considerations which cast doubt on policy makers' and program officials' incentives to fund marginal projects. They are rather inclined to support projects that are likely winners, so that they can credit themselves with the success of subsidized start-ups, even

though their marginal contribution might be small. For our analysis, we cannot exclude those effects, as we use only variables indicating private returns. However, on this basis, the selection bias seems to be weak since, on the one hand, the support of the propensity scores for the subsidized and nonsubsidized firms overlap to a very high degree (Figure 5.2), while on the other hand, in a companion study (Cantner and Kösters (2009a) or Chapter 4, respectively) we find that selectivity is mainly based on novelty and the availability of appropriate programs (favoring academic spin-offs and product start-ups).

In addition, the sheer enormity of subsidization (remember that 42.6% of R&D-performing start-ups receive public R&D funds in our sample) points to likely market distortions. This generous availability of public R&D funds may thwart the development of a market for private R&D funding, since the highly innovative subset of start-ups analyzed here should be also of interest for private venture capital firms. In this way, the fact of existing subsidies is the rationale for the need of ongoing subsidization.

6. Conclusions

This thesis is comprised of four empirical studies analyzing policy measures that are offered to nascent and young entrepreneurs along the founding process. All empirical analyses are based on interview data collected in the East German state of Thuringia. This chapter summarizes the main results (Section 6.1) and highlights implications (Section 6.2).

6.1 Main results

The first study (Chapter 2) demonstrates that the rationale for financial subsidies to new firms is not soundly based in theory or on evidence. Therefore the policy recommendations as to the targeting of policy measures are ambiguous. Analyzing financial support schemes in the form of general grants, soft loans, and loan guarantees, (multinomial) logistic regressions show that the actual allocation of financial subsidies neither follows the rationale of positive external effects nor the rationale of capital market imperfections. A policy allocation that does not target potential market failure is argued to be ineffective because start-ups receive subsidies even though they do not need them. A matching approach supports this conjecture: financial support in the form of grants, soft loans, and loan guarantees does not appear to affect employment growth and credit rating after three business years. However, this does not mean that ineffective subsidies have no effect at all. In addition to distortions resulting from the taxation needed for such policy intervention, these subsidies are likely to distort market selection because they confer upon their recipients an artificial competitive edge.

Policy support measures are not only justified on the basis of alleged incidences of market failure but are also provided for sociopolitical reasons. Start-up subsidies to the unemployed have been evaluated favorably to date, suggesting that they lead to higher employment and higher earnings of formerly unemployed recipients (Caliendo et al., 2008). Nevertheless, these results stem from partial analyses and a more comprehensive evaluation should take into consideration overall economic effects and potential market distortions.

Public business assistance in the founding process is analyzed in Chapter 3. This policy instrument circumvents the problem of market distortions since it targets individual nascent entrepreneurs before they enter the market. Despite their focus on various target groups, business assistance schemes are generally open to nearly everyone since they aim to “build winners” who will later contribute to structural change and economic growth.

Therefore, policy induced selectivity in this arena can be considered low, whereas we find distinct evidence of self-selection by founders into particular forms of business assistance. The analysis suggests that a lack of entrepreneurial resources is the chief impetus for selecting into intensive strategically-oriented business assistance and for perceiving such assistance as useful. Low entrepreneurial resources are defined as a lack of entrepreneurial experience or role models, a lack of social capital, or a weak entrepreneurial personality profile. However, propensity score matching cannot identify any effect of business assistance on subsequent business performance as proxied by initial capital (at the beginning of the first business year), employment, and credit rating (in the third business year).

Chapters 4 and 5 analyze R&D subsidies. The rationale for public support of R&D is less problematic than the rationales offered for other types of policy support because private R&D activity has been shown to be hampered by both credit constraints and a lack of appropriability. To ensure that R&D subsidies are effective and efficient, policymakers and program officials should identify ex-ante those projects that promise high social returns but that, in the absence of a subsidy, would not be undertaken (either not at all or at a smaller scale) because the expected private returns are too low. Hence, projects expected to be privately profitable and, therefore, those that will be undertaken anyway, should not receive public support. Given fundamental information problems in identifying incidences of market failure ex-ante, the discussion in Chapter 4 suggests that policymakers and program officials do, at least to some degree, pursue a strategy of "picking the winner", i.e., award subsidies to start-ups with promising ex-ante characteristics (e.g., an innovative business idea). Considering this selection bias between subsidized and non-subsidized start-ups, we find that R&D subsidies are highly effective in inducing higher employment growth and higher patent activity (Chapter 5). Moreover, the analysis points to the policy focus on academic spin-offs since for some of these highly innovative start-ups, no non-subsidized counterparts can be found in the matching procedure.

What are the general "take away" points from these separate analyses? First, the *rationale behind policy making* must clearly justify policy intervention. Chapter 2 suggests the need of more scrutiny of the positive external effects and capital market imperfections rationales used to justify subsidization of start-up activity since neither is theoretically or empirically devoid of controversy. Additionally, Chapter 3 throws doubt on the need for the public provision of operationally-oriented business assistance since its usefulness is unlikely to be affected by either asymmetric information or by a lack of appropriability. Although

sociopolitical reasons for policy intervention (i.e., policy intended to improve the economic status of disadvantaged groups) are unlikely to dominate in the innovative industries covered by this thesis, such reasons might well explain the lack of targeting assistance toward the avoidance of market failure.

Having a clear-cut rationale for policy intervention is the only way *precise policy targeting* becomes possible. Precise policy targeting toward incidences of market failure will direct public funds where they are most needed and thus where they will be most effective and efficient. This thesis emphasizes the difficulties of policy targeting toward incidences of market failure in that policymakers and program officials have to identify such situations ex-ante. The difficulty of this task calls into question the advisability of ever subsidizing entrepreneurial activity because such subsidization runs the risk of blocking the emergence of a private market for start-up financing (e.g., venture capital). It could turn out that by providing public funds in the first place, the government will be doomed to forever provide public funds. Two different approaches to policy targeting deal with these ex-ante information problems and aim to minimize market distortions arising from public policy intervention. The first of these, providing business assistance schemes in the founding process, aims at "building winners". These schemes demonstrate little if any ex-ante selectivity but are, instead, open to nearly everyone (Chapter 3). Therefore, non-selective business assistance can be viewed as an enabling policy that focuses on individual nascent entrepreneurs prior to their respective start-ups entering the market (i.e., before the time when subsidies can cause distortions). The second approach, what is called "picking the winner", aims at allocating public funds in favor of those founders and start-ups that have, ex-ante, the most promising characteristics (Chapter 4). The strategy of "picking the winner" minimizes market distortions because it allocates public funds to those start-ups that are already highly competitive and thus the receipt of public funds does not constitute a decisive artificial competitive edge.

The rationale behind any public policy intervention and the ability to allocate funds accordingly is likely to affect *policy effectiveness*. The rationale behind public policy intervention in R&D is the clearest of all those studied in this thesis because R&D activity is known to be affected by capital market imperfections and a lack of appropriability (Arrow, 1962; Hall, 2002). Consistently, the analyses conducted in Chapter 5 provide evidence of the effectiveness of R&D subsidies in inducing additional employment and patent activity. The economic rationale behind financial subsidies such as grants, soft loans, and loan guarantees is far more controversial. As discussed in Chapter 2, these subsidies seem to be ineffective in targeting either capital market imperfections or positive

external effects. Insignificant estimates from propensity score matching suggest that these policy measures do not impact business performance but, instead, constitute windfall gains.

6.2 Implications

The studies contained in this thesis do not evaluate single policy schemes but aggregate measures of different, albeit similar, programs. This is an effective evaluation approach in light of the bewildering range of ever-changing policy schemes. However, less fragmented business assistance schemes would clearly facilitate quantitative evaluations by providing a meaningful number of cases. This thesis thus points out the necessity of restructuring the provision of assistance throughout the entrepreneurial process and the high desirability of taking into consideration how policies will be evaluated at the time the policies are being designed, e.g., by realizing more experimental designs to strengthen causal inferences. In short, a stronger "evaluation spirit and culture" at all levels of policy design, implementation, and delivery is needed. This is all the more important, since evaluations have to investigate *long-run* effects of policy interventions. Like most other evaluations, only short-run effects are investigated in this thesis. For example, in Chapters 2 and 5, the simultaneous impact of financial subsidies is investigated, since the subsidization had occurred sometime between the first and third business year and the outcome variables were measured in the third business year. The effect of business assistance in the nascent phase was studied with respect to performance differences in the third business year (Chapter 3).

In addition to having a sound rationale for policy intervention (either positive external effects, capital market imperfections, or sociopolitical reasons in case of labor market policies) and estimating the effectiveness of policy support, policymakers must consider the opportunity costs of interventions. Hence, the efficiency of existing policy schemes must be investigated, which was not attempted in this thesis. Future evaluations should consider not only the direct effects of policy intervention but also the costs of programs, including the costs of higher taxes to fund the programs and the market distortions arising due to the rich subsidy environment. Information about indirect effects of public policy intervention would shed light on whether, in aggregate, policy schemes really do improve the overall situation for nascent and young entrepreneurs. However, indirect effects like market distortions arising on input or output markets of subsidized start-ups are virtually impossible to track – let alone distortions resulting from the tax system and their influence on entrepreneurial activity.

Furthermore, policymakers need to acknowledge the scope of support policies for entrepreneurs along the founding process. Sternberg (1996) points out that many policy initiatives are oriented toward backward regions in an effort to spur high-tech growth, but policy support measures for innovative entrepreneurship will not level out regional disparities for two reasons.

First, the strategy of stimulating innovative entrepreneurship in backward regions will be hampered by the high persistence and path-dependency of start-up-rates over time. Analyzing data from West Germany for the period from 1983 to 2002, Fritsch and Mueller (2007) find that a region's entrepreneurial culture and its level of innovative activity exert a strong impact on subsequent new firm formation. Therefore, changes in regional start-up activity are small and emerge only over a long time period. Similarly, Minniti (2005) highlights the importance of a community's entrepreneurial history in explaining the effectiveness of entrepreneurship policy measures, since an entrepreneurial climate (as indicated by a large concentration of entrepreneurs) encourages individuals to become entrepreneurs themselves. The long-run time horizon of policy intervention supports the use of enabling policies that pursue a strategy of "building winners". Such a policy focus would require a major shift in actual policymaking – away from targeting start-ups and established firms and toward empowering the individual (potential) entrepreneur. Enabling policies could encompass the kind of programs suggested by Schmitt-Rodermund and Vondracek (2002). Since career interests are formed early in adolescence, these scholars recommend helping adolescents to discover their interests and abilities and making them aware of entrepreneurship as a career option. To effectively "build winners", this kind of entrepreneurship education should be offered to all adolescents, i.e., all potential future entrepreneurs. Thereafter, special training should be provided for those who have the right combination of personality and entrepreneurial orientation.

Second, not only is it difficult to change the level of path-dependent entrepreneurial activity over time, but the effects of entrepreneurial activity also differ across regions. Since the impact of new firm formation is strongly dependent on the interplay between contextual factors and firms, the impact of start-ups can be expected to be shaped by the regional availability of, e.g., venture capital, a qualified workforce, and other innovative firms, as well as by a supportive infrastructure (Fritsch, 2008). Fritsch and Mueller (2008) find distinct interregional differences in the effects of start-up activity. Their analyses suggest that start-ups exert a higher impact in agglomerations as well as in regions with a high level of labor productivity.

In summary, policymakers need to be aware that entrepreneurial activity is of a long-term nature, and can barely be "created" in the short-run. Moreover, the effects of entrepreneurial activity also are only observable in the very long-run and depend on regional characteristics. Therefore, the effectiveness and efficiency of policy support measures for innovative entrepreneurship differ across regions. To date, policymakers have been mainly in favor of balanced regional growth, which is reflected in start-up subsidies given for sociopolitical reasons. However, Sternberg (1996) points out that policy support for high-tech regions that strengthens international competitive advantage has to accept the fact of increasing interregional disparities between growing and lagging regions.

Public choice considerations

In contrast to welfare economics, public choice scholars do not assume a benevolent dictator as the single policymaker, but instead consider utility-maximizing politicians, bureaucrats, and voters interacting on a political market. Rooted in this very different assumption, public choice theory offers several explanations for the subsidy environment currently experienced by entrepreneurs (i.e., potential, nascent or young entrepreneurs).

First, public choice theory suggests that policymakers and funding authorities may have incentives that actually conflict with a policy targeting market failure. For instance, policymakers and program officials may wish to be seen as the engineers of success (Lerner, 1999) and thus they choose projects that have a high probability of success instead of funding projects which are likely to be affected by market failure (Stiglitz and Wallsten, 2000). The frequent absence of specific objectives in entrepreneurship policy programs (as criticized by Storey, 2000) can also be explained by public choice theory. Policymakers with only fuzzy objectives, if they have any at all, can more easily emphasize the successful parts of their programs and even reinterpret its goals in a self-serving manner during an election period to maximize votes.

Second, the multitude and extent of policy schemes (coming from innovation policy, SME policy, entrepreneurship policy, and labor market policy) which are delivered at the local, *Länder*, federal, and European level finds some explanation in Niskanen's (1971) model of the budget maximizing bureaucrat. According to Niskanen, rational bureaucrats maximize – among other things – influence, reputation, and power, which are in total approximated by budget size. Increases of budgets (and the consequent increase in influence, reputation, and power) can be achieved by promoting and implementing more and more policy schemes targeted at the entrepreneurial process. Pages et al. (2003, p. 256) label this phenomenon "program-itis" and it has the potential to result in redundancy and

ineffectiveness when these schemes are not part of a comprehensive entrepreneurship strategy.

Third, in contrast to economic development strategies that target established firms, policy support of innovative entrepreneurship encompasses measures targeted at the individual (potential, nascent, or young) entrepreneur. These enabling policies can take a very long time before they eventually may manifest in increased start-up rates. Moreover, their effects are difficult to track and are often not obvious to the public. The theory of political business cycles (e.g., Nordhaus, 1975) suggests that opportunistic utility-maximizing incumbent policymakers try to use expansionary economic policy to create favorable macroeconomic conditions so as to increase their chances of re-election. However, entrepreneurship policies with their very long lead times and no obvious impact cannot be timed to have a positive effect on the economy at the end of a specific legislative period. Therefore, Pages et al. (2003) suggest that policymakers will favor more direct types of policy intervention, which explains why enabling policies focused on "soft" policy measures like consulting and awareness building still constitute a tiny fraction of economic policy measures.

Future researchers making policy recommendations for effectively supporting innovative entrepreneurship should thus consider the potentially distortive policy response to their advice (Jones and Cullis, 1993). Since the "policy process always influences the content of policy" (Pages et al., 2003, p. 228), taking this precaution will ensure that alleged market failure (which is accused of hampering innovative entrepreneurial activity) does not result in proven policy failure.

A—Appendix to Chapter 2

A.1 Exploring self-selection and program selection

Table A.1 shows the results of a multinomial logistic regression which analyzes the relationship between start-ups' ex-ante characteristics (independent variables) and the status of subsidization which distinguishes between "Receipt of subsidies" (base outcome), "Self-selection out of subsidization" and "Refusal / Program selection".[89]

	Multinomial logistic regression	
Dependent variable	Base outcome: subsidization	
	Self-selection out of subsidization	Refusal / Program selection
Novelty	-0.166	0.077
Growth goals	0.504	0.589
University degree	-0.536	0.527
Previous self-employment	0.443	0.981
Team start-up	-0.359	-0.487
Initial capital	-0.606***	-0.455
Year 1998–2001	-0.772*	-0.830
Year 2002–2006	-0.884*	-1.087
Nace 2	-1.549**	-2.836**
Nace 3	-0.156	-1.684*
Nace 7	0.656	-1.742**
Constant	-2.979***	1.066
Number of observations	66	22
	158	
Log likelihood	-135.389	
Pseudo-R^2	0.1430	

Note: Due to one refusal for the reasons of non-take-up the estimations are based on 158 observations.
Base outcome: Receipt of subsidies

Table A.1: Multinomial logistic regression estimating predictors of self-selection and program selection

The multinomial logistic regression reveals that if a start-up is operating in the chemical industry, metalworking industry and engineering (*Nace 2*) the more likely it is subsidized rather than being subject to self-selection or program selection. The significant industry dummies in the third column suggest that start-ups from miscellaneous industries – which cannot be assigned to well established industries – are more likely to be rejected during the application procedure rather than being subsidized. All other variables which might distinguish subsidized start-ups from start-ups whose applications were rejected are

[89] These categories were built based on nonsubsidized founders' responses to the question why they have not been subsidized (cf. Section 2.3.2).

insignificant. Hence, program selection seems to be solely based on industry characteristics suggesting that policymakers and program officials either cannot identify or cannot target start-ups according to characteristics as captured by variables like, e.g., *Novelty*, *Growth goals* and *University degree*.

Start-ups are less likely to self-select out of subsidization the younger they are (i.e. founded after 1998) which might be explained by the increased range of subsidies which have become available over time. Start-ups are also more likely to abstain from subsidy programs rather than being subsidized when they have only little initial capital. Perhaps, these founders see no need for a higher capital base and, therefore, no need for subsidies which might explain their self-selection.

A.2 Variable choice and estimation of the propensity score

A propensity score model must be estimated for each outcome variable, including those variables that influence both the receipt of subsidies as well as the respective outcome variable. To identify these variables, I look for variables that correlate with the receipt of subsidies and simultaneously with the respective success measure (employment growth and survival) (Table 2.3). Moreover, I conduct multivariate analyses to identify other distinguishing characteristics between subsidized and nonsubsidized start-ups that have an impact at the same time on employment growth and survival, respectively. In the following, the variable choice for each propensity score model is explained.

Employment growth. Table 2.3 shows that the variables *Previous self-employment* and *Nace 2* are correlated with both the take-up of subsidies as well as employment growth. Initial capital varies greatly between subsidized and nonsubsidized start-ups. Although not in line with the present data, previous studies suggest that initial capital impacts on employment growth (e.g., Cooper et al., 1994). I thus include *Initial capital* as a balancing variable. Initial matching procedures show that the matched samples differed in founders' *Growth goals*. Since ambitions have also been found to impact on realized employment growth (Wiklund and Shepherd, 2003), this variable is also included.[90] Ordinary least squares regressions cannot identify other joint influencing factors of subsidization and employment growth, so that the propensity score is finally estimated with the variables *Initial capital*, *Previous self-employment*, *Growth goals*, and the industry dummies.

Credit rating. Only the variable *Previous self-employment* is correlated with both the receipt of subsidies as well as with survival as proxied by the credit rating (Table 2.3). Additionally, I balance subsidized and nonsubsidized start-ups on the basis of *Initial capital* and industry because financial endowment and industry characteristics strongly differentiate between subsidized and nonsubsidized start-ups and have been shown to impact on the survival probability of start-ups (e.g., Cooper et al., 1994). Since ordinary least squares regression models cannot reveal any further predictors of credit rating that distinguish between subsidized and nonsubsidized start-ups, the propensity score model is estimated with the variables *Previous self-employment*, *Initial capital*, and the industry dummies.

[90] This approach follows Rubin and Thomas (1996, p. 253), who recommend including a variable in doubt "unless […] it can be excluded because there is a consensus that it is unrelated to the outcome variables or not a proper covariate".

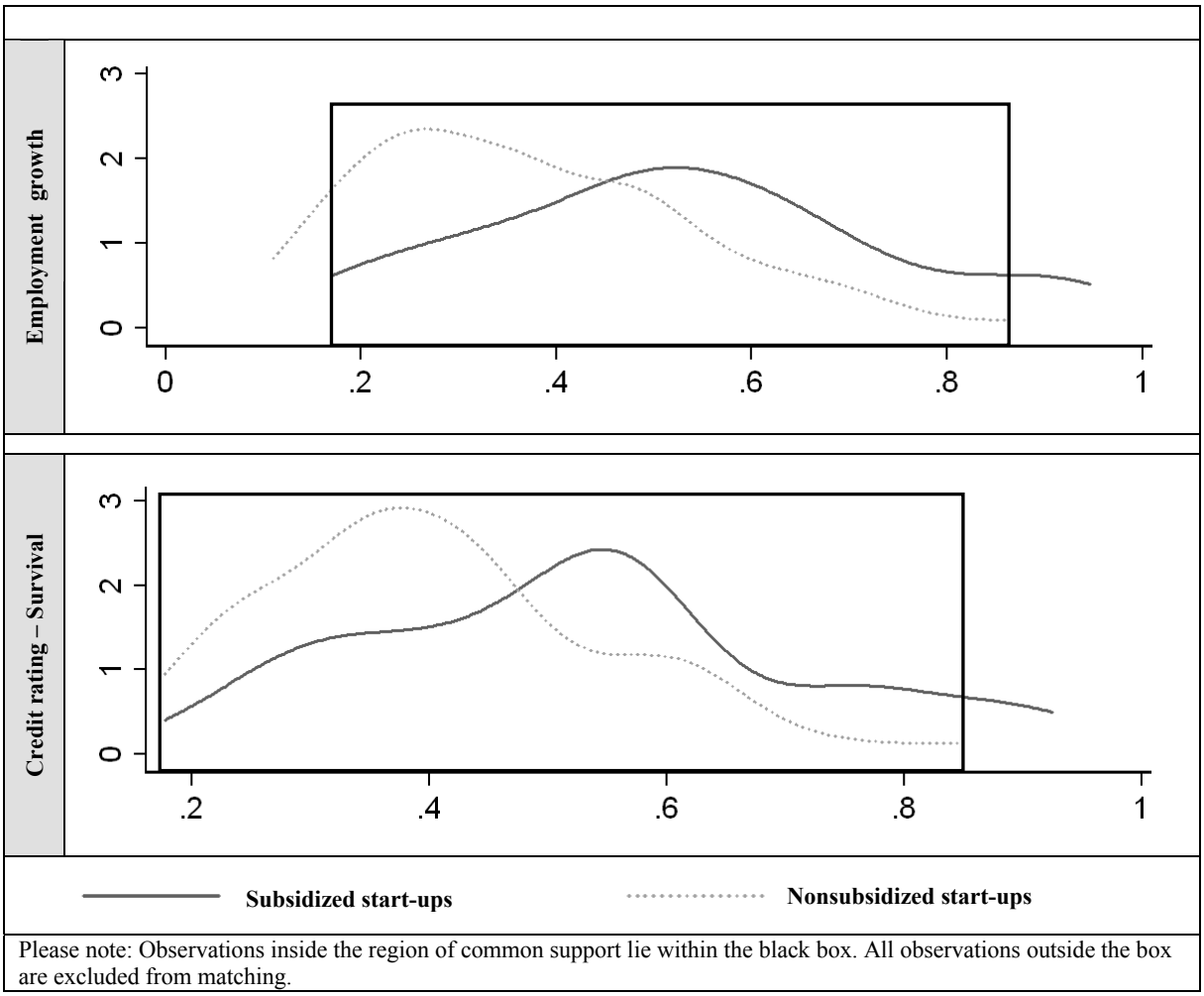
The propensity to receive subsidies is estimated with a logit model (Table A.2). In accordance with the discussion above, the selected variables for each of the two models are regressed on the binary dependent variable *Subsidy* (i.e., take-up of financial subsidies within the first three business years). Since we are primarily interested in prediction and data reduction, redundancy and collinearity are of little account (Smith, 1997). However, this limits the interpretation of the coefficients, which are not further discussed here.

	Employment growth	**Credit rating – Survival**
Dependent variable: *Subsidy*		
Growth goals	-0.450	
Previous self-employment	-0.492	-0.479
Initial capital	0.515 ***	0.397**
Nace 2	1.827 ***	1.586**
Nace 3	0.469	0.248
Nace 7	0.975 **	0.912*
Constant	-2.113 ***	-1.851**
N	159	125
LR chi2 (k)	(6) 27.54	(5) 16.28
Prob > LR	0.0001	0.0061
McFadden's R2	0.1263	0.0943
Note: * p < 0.1; ** p < 0.05; *** p < 0.01		

Table A.2: Estimation of the propensity score

A.3 Imposition of the common support

The common support condition ensures that any set of characteristics of subsidized start-ups (captured by the propensity score) can also be observed for nonsubsidized ones. The kernel density functions (Figure A.1) illustrate the distribution of the propensity score for subsidized and nonsubsidized start-ups.[91] The region of common support is found in the overlap and requires discarding 11 (4) observations from the analysis of employment growth (credit rating).



Please note: Observations inside the region of common support lie within the black box. All observations outside the box are excluded from matching.

Figure A.1: Distribution of the propensity score: employment growth (top), credit rating (bottom)

[91] The kernel density estimate is calculated using a Gaussian kernel function. The bandwidth is specified by Stata, using the kdensity function.

A.4 Matching quality

T-tests for equality of means in the subsidized and nonsubsidized start-ups indicate the balancing of the variables before and after matching (Table A.3).

	Before matching		**Employment growth** **After matching**		**Credit rating** **After matching**	
	Mean of…		Mean of matched…		Mean of matched…	
	… subsidized start-ups **N = 70**	… nonsubsidized start-ups (potential controls) **N = 89**	… subsidized start-ups **N = 66**	… nonsubsidized start-ups (actual controls) **N = 84**	… subsidized start-ups **N = 54**	… nonsubsidized start-ups (actual controls) **N = 67**
Novelty	0.61	0.62	0.52	0.58	0.56	0.57
Growth goals	0.57	0.62	0.55	0.59	0.52	0.66
University degree	0.73	0.67	0.73	0.63	0.74	0.69
Previous self-employment	**0.31**	**0.45**	0.34	0.37	0.35	0.39
Team start-up	0.69	0.63	0.70	0.61	0.67	0.61
Initial capital	**3.47**	**2.89**	3.20	3.21	3.28	3.35
Year 1994–1997	0.37	0.49	**0.34**	**0.50**	0.37	0.48
Year 1998–2001	0.39	0.35	0.41	0.34	0.43	0.35
Year 2002–2006	0.24	0.16	0.25	0.16	0.20	0.17
Nace 2	**0.27**	**0.08**	0.20	0.19	0.20	0.18
Nace 3	0.19	0.20	0.20	0.21	0.20	0.21
Nace 7	0.36	0.30	0.39	0.39	0.39	0.38
Nace x	**0.19**	**0.42**	0.20	0.21	0.20	0.23
Employment growth	0.96	0.83	0.95	0.61	0.97	0.60
Rating	298.16	292.15	303.97	283.41	302.63	291.45
Propensity score (Employment growth)	**0.53**	**0.37**	0.49	0.48	**-**	**-**
Propensity score (Rating)	**0.53**	**0.41**	**-**	**-**	0.50	0.49

Please note: The balancing of the variables is shown after kernel matching with the optimal bandwidth. Bold numbers indicate significant different means between observation from subsidized start-ups and nonsubsidized start-ups before and after matching in a two-sided t-test (10% significance level). Because of the imposition of the common support (see Appendix A.3), the matched samples have fewer observations.

Table A.3: Group differences between subsidized and nonsubsidized start-ups before and after matching

After matching, subsidized and nonsubsidized start-ups differ only with respect to *Year 1994–1997* in the analysis of employment growth. This should not be of concern since there is no evidence that this variable impacts on employment growth.

B—Appendix to Chapter 3

B.1 Correlation tables

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
(1)	**Bus. assistance (General)**	-																								
(2)	**Usefulness**	-	-																							
(3)	**Initial capital**	0.00	0.18**	-																						
(4)	**Employment**	-0.04	0.07	0.28***	-																					
(5)	**Rating**	0.03	-0.14	0.02	-0.13**	-																				
(6)	**Academic spin-off**	0.15***	-0.01	0.04	0.10**	0.06	-																			
(7)	**Novelty**	0.05	0.03	0.11**	-0.01	0.11**	0.31***	-																		
(8)	**Previous self-employment**	-0.18***	-0.11	0.06	-0.07	0.10*	-0.06	0.09*	-																	
(9)	**Self-employed parents**	-0.06	-0.04	0.02	0.12**	-0.01	-0.02	0.00	0.11**	-																
(10)	**Social capital (weak)**	0.09*	-0.03	0.05	0.08	0.03	0.02	0.01	-0.11**	-0.07	-															
(11)	**Social capital (strong)**	0.07	0.04	-0.03	0.02	0.02	-0.00	-0.04	-0.08	-0.03	0.25***	-														
(12)	**Team start-up**	-0.02	-0.02	0.09*	0.13***	0.00	0.20***	0.07	0.03	0.02	0.01	0.08	-													
(13)	**Conscientious-ness**	-0.03	0.06	0.04	0.04	-0.02	-0.08*	-0.01	-0.03	-0.01	0.04	-0.02	0.00	-												
(14)	**Extraversion**	-0.02	0.06	-0.03	0.08*	-0.08	-0.05	0.03	0.05	0.05	-0.04	0.03	-0.01	0.19***	-											
(15)	**Agreeableness**	0.04	0.01	-0.04	0.02	-0.07	0.09*	-0.04	-0.03	0.04	0.06	0.01	0.04	0.16***	0.05	-										
(16)	**Openness**	0.04	-0.10	0.01	-0.05	0.01	0.04	0.14***	0.01	-0.04	0.02	-0.02	0.02	0.12**	0.31***	0.04	-									
(17)	**Neuroticism**	0.01	-0.12*	0.01	-0.13***	0.12**	-0.00	-0.03	0.05	-0.05	-0.02	-0.02	0.06	-0.29***	-0.31***	-0.16***	-0.25***	-								
(18)	**Entr. Personality profile**	-0.05	0.03	0.03	0.06	-0.02	-0.08*	0.10**	0.01	-0.00	-0.02	-0.00	-0.04	0.37***	0.60***	-0.48***	0.54***	-0.43***	-							
(19)	**Current life satisfaction**	-0.01	0.18**	0.02	0.01	-0.18***	0.05	0.09*	0.03	0.07	-0.04	0.03	0.01	0.20***	0.16***	0.05	0.07	-0.23***	0.16***	-						
(20)	**Year 1994–1997**	-0.15***	-0.02	-0.03	-0.04	-0.16***	-0.13***	-0.09*	-0.10**	0.06	-0.04	-0.06	-0.03	0.05	0.07	-0.04	-0.08*	0.03	0.05	0.03	-					
(21)	**Year 1998–2001**	0.03	0.03	-0.01	0.04	-0.02	0.12***	-0.03	0.06	-0.02	0.00	0.00	0.00	-0.09*	-0.11**	0.00	-0.05	-0.03	-0.12**	-0.04	-0.61***	-				
(22)	**Year 2002–2006**	0.13***	-0.01	0.05	-0.00	0.19***	0.01	0.14***	0.05	-0.04	0.05	0.08	0.04	0.04	0.04	0.05	0.15***	0.00	0.07	0.00	-0.47***	-0.42***	-			
(23)	**Nace 2**	-0.04	-0.06	0.16***	0.24***	-0.12**	-0.11**	0.01	-0.01	0.03	0.01	-0.03	-0.05	0.08	0.04	0.04	-0.13***	0.01	-0.04	0.01	0.06	-0.03	-0.03	-		
(24)	**Nace 3**	0.01	0.03	0.11**	0.06	-0.02	0.14***	0.23***	-0.04	-0.05	0.08	-0.01	0.07	0.02	-0.08	-0.09**	0.01	0.03	0.01	0.03	0.09*	-0.05	-0.05	-0.30***	-	
(25)	**Nace 7**	0.06	0.04	-0.17***	-0.17***	0.13**	0.09*	-0.05	0.03	0.00	-0.01	0.04	0.01	-0.13***	0.01	0.00	0.12**	-0.02	0.01	0.03	-0.15***	0.07	0.09*	-0.41***	-0.42***	-
(26)	**Nace x**	-0.04	-0.03	-0.08*	-0.11**	-0.00	-0.15***	-0.21***	0.02	0.02	-0.09*	0.00	-0.03	0.06	0.03	0.06	-0.01	-0.03	0.03	-0.07	0.02	-0.01	-0.02	-0.25***	-0.26***	-0.35**

Note: * p < 0.1; ** p < 0.05; *** p < 0.01. The correlations with the variable *Usefulness* include only those 194 observations that took up business assistance.

Table B.1: Correlation matrix for the overall sample (N=425; pairwise deletions because of refusals for several variables)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
(1)	Bus. assistance (Cluster 1)	-																								
(2)	Usefulness	-	-																							
(3)	Initial capital	-0.02	0.14	-																						
(4)	Employment	0.00	0.15	0.26***	-																					
(5)	Rating	0.09	-0.14	0.04	-0.15**	-																				
(6)	Academic spin-off	0.27***	0.05	0.03	0.11**	0.04	-																			
(7)	Novelty	0.17***	0.11	0.15***	0.03	0.09	0.31***	-																		
(8)	Previous self-employment	-0.17***	-0.16	0.03	-0.11*	0.12**	-0.08	0.04	-																	
(9)	Self-employed parents	-0.05	-0.16	0.00	0.12**	0.00	-0.04	-0.03	0.08	-																
(10)	Social capital (weak)	0.12**	-0.23**	0.04	0.05	0.00	0.05	0.05	-0.13**	-0.03	-															
(11)	Social capital (strong)	0.04	-0.09	-0.07	0.01	-0.02	0.03	-0.02	-0.06	0.00	0.24***	-														
(12)	Team start-up	-0.01	0.02	0.12**	0.14**	0.02	0.22***	0.07	-0.01	0.00	0.03	0.07	-													
(13)	Conscientious-ness	-0.05	0.04	0.03	0.03	-0.03	-0.08	-0.03	-0.03	-0.04	0.04	0.01	0.01	-												
(14)	Extraversion	-0.04	0.06	-0.08	0.09	-0.08	-0.06	-0.02	0.03	0.03	-0.04	0.02	-0.02	0.19***	-											
(15)	Agreeableness	0.00	0.07	-0.06	0.00	-0.08	0.10*	-0.09*	-0.03	0.04	0.05	-0.01	0.06	0.11*	0.03	-										
(16)	Openness	0.07	-0.21**	0.05	-0.01	0.04	0.04	0.13**	0.02	-0.10*	0.06	-0.01	0.06	0.15***	0.29***	0.04	-									
(17)	Neuroticism	0.03	-0.14	0.03	-0.14**	0.10*	0.00	-0.02	0.08	0.01	-0.06	-0.04	0.08	-0.27***	-0.31***	-0.17***	-0.27***	-								
(18)	Entr. Personality profile	-0.03	-0.09	0.03	0.10*	-0.01	-0.09	0.10*	-0.01	-0.06	0.01	0.02	-0.05	0.40***	0.61***	-0.49***	0.54***	-0.43***	-							
(19)	Current life satisfaction	-0.06	0.31***	0.07	0.02	-0.16***	0.08	0.07	0.03	0.03	0.02	0.02	-0.04	0.21***	0.17***	0.02	0.03	-0.21***	0.18***	-						
(20)	Year 1994–1997	-0.20***	0.03	-0.02	-0.08	-0.13**	-0.16***	-0.08	-0.09*	0.04	-0.09	-0.06	-0.04	0.03	0.04	-0.03	-0.10*	0.08	0.02	0.05	-					
(21)	Year 1998–2001	0.05	-0.02	-0.03	0.04	-0.06	0.15***	-0.01	0.05	-0.01	0.04	0.03	-0.01	-0.04	-0.07	0.04	-0.04	-0.04	-0.11**	-0.03	-0.61***	-				
(22)	Year 2002–2006	0.17***	-0.01	0.05	0.05	0.21***	0.01	0.10*	0.05	-0.03	0.05	0.04	0.06	0.01	0.02	-0.01	0.15***	-0.05	0.10*	-0.02	-0.46***	-0.42***	-			
(23)	Nace 2	-0.13**	-0.11	0.10*	0.20***	-0.11*	-0.11**	0.00	-0.02	0.06	0.00	-0.08	-0.06	0.09*	0.04	0.06	-0.12**	0.03	-0.05	0.01	0.09*	-0.01	-0.09*	-		
(24)	Nace 3	0.06	-0.01	0.13**	0.08	0.03	0.16***	0.25***	-0.10*	-0.10*	0.09*	0.00	0.05	0.02	-0.08	-0.11**	0.04	0.03	0.04	0.01	0.06	-0.07	0.00	-0.30***	-	
(25)	Nace 7	0.10*	0.11	-0.17***	-0.18***	0.11*	0.07	-0.04	0.06	0.01	-0.02	0.02	0.03	-0.16***	-0.01	-0.02	0.06	-0.05	0.00	0.05	-0.19***	0.12**	0.08	-0.39***	-0.44***	-
(26)	Nace x	-0.05	-0.03	-0.05	-0.08	-0.06	-0.15***	-0.24***	0.05	0.04	-0.08	0.06	-0.03	0.08	0.06	0.09*	-0.01	-0.01	0.02	-0.09	0.06	-0.06	-0.01	-0.24***	-0.27***	-0.35***

Note: * p < 0.1; ** p < 0.05; *** p < 0.01; The correlations with the variable "usefulness" include only those 96 observations which took up business assistance (Cluster 1).

Table B.2: Correlation matrix for the Cluster 1 sample (i.e., all nonassisted and all Cluster 1 observations; N=347; pairwise deletions because of refusals for several variables)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
(1)	Bus. assistance (Cluster 2	-																								
(2)	Usefulness	-	-																							
(3)	Initial capital	0.02	0.24**	-																						
(4)	Employment	-0.06	0.01	0.35***	-																					
(5)	Rating	-0.04	-0.20*	0.02	-0.10*	-																				
(6)	Academic spin-off	-0.02	-0.21**	-0.01	0.09*	0.06	-																			
(7)	Novelty	-0.07	-0.11	0.08	-0.03	0.11*	0.21***	-																		
(8)	Previous self-employment	-0.15***	-0.10	0.07	-0.08	0.13**	0.01	0.14***	-																	
(9)	Self-employed parents	-0.06	0.06	0.01	0.14**	-0.07	-0.07	0.03	0.05	-																
(10)	Social capital (weak)	0.05	0.11	0.11**	0.13**	0.03	-0.03	-0.01	-0.06	-0.07	-															
(11)	Social capital (strong)	0.08	0.14	-0.02	0.03	-0.02	-0.04	-0.03	-0.03	-0.04	0.24***	-														
(12)	Team start-up	-0.03	-0.06	0.06	0.14***	-0.03	0.14***	0.06	0.05	0.01	0.02	0.07	-													
(13)	Conscientious-ness	-0.01	0.10	0.06	0.07	-0.04	-0.06	0.01	-0.02	-0.01	0.00	0.00	0.00	-												
(14)	Extraversion	0.01	0.07	-0.03	0.09*	-0.08	0.03	0.06	0.02	0.01	-0.03	0.03	0.03	0.21***	-											
(15)	Agreeableness	0.07	-0.03	-0.04	-0.01	-0.09	0.13**	-0.03	-0.04	0.04	0.04	-0.02	0.01	0.19***	0.09*	-										
(16)	Openness	-0.01	-0.03	-0.04	-0.04	-0.03	0.06	0.12**	0.02	-0.02	0.01	-0.03	0.02	0.12**	0.33***	0.06	-									
(17)	Neuroticism	-0.01	-0.14	0.02	-0.17***	0.16***	0.00	-0.03	0.04	-0.08	0.01	0.01	0.04	-0.33***	-0.35***	-0.15***	-0.26***	-								
(18)	Entr. Personality profile	-0.06	0.14	0.02	0.10*	-0.04	-0.05	0.10*	0.01	-0.01	-0.02	0.00	-0.01	0.37***	0.60***	-0.45***	0.55***	-0.47***	-							
(19)	Current life satisfaction	0.04	0.11	0.01	0.02	-0.21***	0.03	0.06	0.05	0.08	-0.09	0.05	-0.01	0.21***	0.15***	0.06	0.07	-0.18***	0.14***	-						
(20)	Year 1994–1997	-0.07	-0.01	-0.01	-0.04	-0.15***	-0.08	-0.08	-0.14***	0.06	-0.01	-0.04	-0.01	0.04	0.06	-0.04	-0.08	0.04	0.03	-0.01	-					
(21)	Year 1998–2001	0.01	0.04	-0.03	0.00	0.01	0.04	-0.05	0.08	-0.02	-0.05	0.00	-0.01	-0.06	-0.06	0.01	-0.05	-0.08	-0.08	-0.01	-0.64***	-				
(22)	Year 2002–2006	0.08	-0.03	0.05	0.04	0.16***	0.05	0.16***	0.08	-0.05	0.07	0.04	0.02	0.01	0.00	0.04	0.16***	0.04	0.05	0.03	-0.47***	-0.38***	-			
(23)	Nace 2	0.04	0.02	0.21***	0.26***	-0.11*	-0.08	0.04	-0.04	0.04	0.01	0.00	-0.04	0.07	0.06	0.04	-0.13**	-0.03	-0.02	0.01	0.02	0.00	-0.02	-		
(24)	Nace 3	-0.04	0.05	0.10*	0.07	0.01	0.10*	0.17***	0.02	0.00	0.05	-0.04	0.11**	0.07	-0.06	-0.11**	-0.02	0.05	0.01	0.02	0.09	-0.07	-0.03	-0.31***	-	
(25)	Nace 7	0.01	-0.03	-0.21***	-0.22***	0.11*	0.09*	-0.02	0.02	-0.04	0.00	0.07	-0.02	-0.16***	-0.02	0.03	0.11**	0.04	-0.03	0.01	-0.14***	0.07	0.08	-0.42***	-0.38***	-
(26)	Nace x	-0.02	-0.03	-0.09*	-0.11*	0.00	-0.13**	-0.20***	0.00	0.00	-0.06	-0.05	-0.04	0.05	0.01	0.04	0.03	-0.08	0.05	-0.04	0.05	-0.01	-0.05	-0.28***	-0.25***	-0.34***

Note: * p < 0.1; ** p < 0.05; *** p < 0.01; The correlations with the variable "usefulness" include only those 98 observations which took up business assistance (Cluster 2).

Table B.3: Correlation matrix for the Cluster 2 sample (i.e., all nonassisted and all Cluster 2 observations; N=349; pairwise deletions because of refusals for several variables)

B.2 Variable choice and estimation of the propensity score

A propensity score model must be estimated for each outcome variable, including those variables that influence both the take-up of assistance as well as the respective outcome variable. These variables can be expected to account for the selection bias (Caliendo, 2006). To identify these variables, we look for variables that correlate with the take-up of business assistance and simultaneously with the respective success measure (initial capital, employment growth, and credit rating). Moreover, we conduct multivariate analyses to identify other distinguishing characteristics between assisted and nonassisted start-ups that have an impact at the same time on initial capital, employment growth, and credit rating, respectively. In the following, the variable choice for the propensity score of each sample is explained.

Overall. Table B.1 shows that the variables *Previous self-employment* and the time dummies correlate both with the take-up of business assistance in general and our outcome variable *Credit rating.* Similarly, being an *Academic spin-off* correlates with both take-up of business assistance and *Employment*. Since the time dummies are a significant predictor of policy take-up and the industry dummies are correlated with most outcome variables, we include these dummies as balancing variables.[92] Similarly, we include the personality traits *Extraversion* and *Neurocitism*. *Extraversion* correlates positively, and the trait *Neuroticism* correlates negatively, with most outcome variables, which is in line with research on the personality-career success-link (Judge et al., 1999). Hence, we estimate the propensity score with the variables *Academic spin-off*, *Previous self-employment*, *Extraversion*, *Neuroticism*, and the year and industry dummies.

Cluster 1. Table B.2 shows that the variables *Academic spin-off*, *Previous self-employment, Novelty*, *Nace 2*, and *Nace 7* are correlated with both the take-up of Cluster 1 business assistance as well as various outcome variables. Similar to the analysis of overall assistance, the Big Five trait *Neuroticism* correlates significantly with *Employment* and *Credit rating*. Again, the year dummies correlate strongly with the take-up of business assistance (as described by Cluster 1) and the industry dummies correlate with most outcomes. Since ordinary least squares regressions cannot identify other joint predictors of the take-up of business assistance characterized by Cluster 1 and our outcome variables and following again the recommendation of Rubin and Thomas (1996, as explained in footnote

[92] This approach follows Rubin and Thomas (1996, p. 253), who recommend including a variable in doubt "unless … it can be excluded because there is a consensus that it is unrelated to the outcome variables or not a proper covariate."

92) the propensity score is finally estimated with the variables *Novelty*, *Academic spin-off*, *Previous self-employment*, *Extraversion*, *Neuroticism*, the year and industry dummies.

Cluster 2. Previous self-employment is the only variable that is correlated with the take-up of Cluster 2 business assistance (Table B.3). However, similar to the correlations described above, the variables *Novelty, Academic spin-off*, *Extraversion*, and *Neuroticism* correlate with various outcomes and are thus included in the propensity score. Additionally, we have to balance Cluster 2 assisted start-ups and nonassisted start-ups on the basis of *Social capital (weak)* because preliminary matching procedures indicated that the matched samples will significantly differ in their weak social capital. Since ordinary least squares regression models cannot reveal any further characteristics which influence our outcome variables and that distinguish between assisted and nonassisted start-ups, the propensity score model is finally estimated with the variables *Novelty*, *Academic spin-off*, *Previous self-employment*, *Extraversion*, *Neuroticism*, and *Social capital (weak)*, as well as with the year and industry dummies.

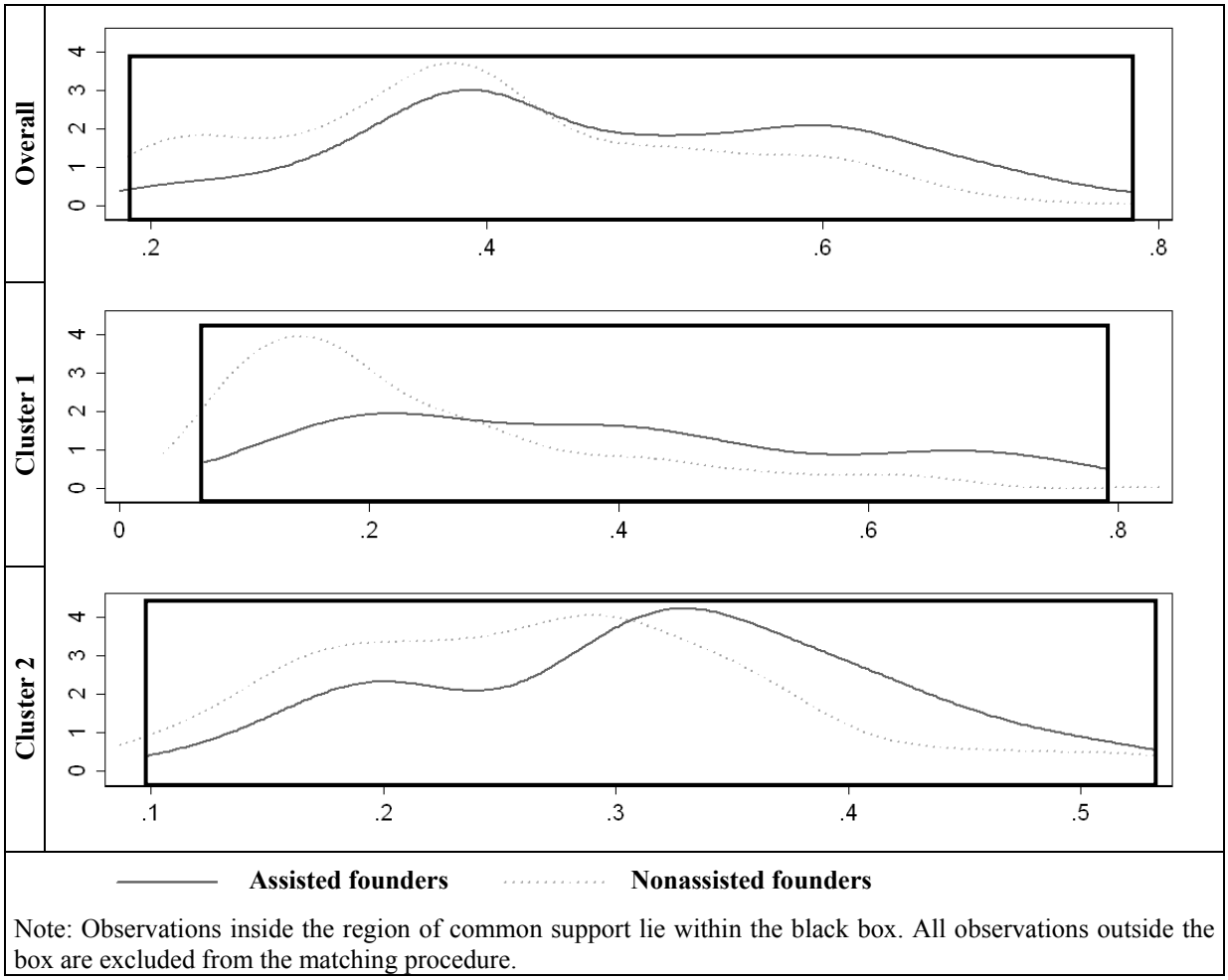
The propensity to take-up business assistance is estimated with a logit model (Table B.4). In accordance with the discussion above, the selected variables are regressed on either the take-up of business assistance in general, Cluster 1 business assistance, or Cluster 2 business assistance. Since we are primarily interested in prediction and data reduction, redundancy and collinearity are of little account (Smith, 1997). However, this limits the interpretation of the coefficients, which are not further discussed here.

	Overall	**Cluster 1 business assistance**	**Cluster 2 business assistance**
Academic spin-off	0.7600**	1.1654 ***	0.0439
Novelty		0.1499 *	-0.1688 *
Previous self-employment	-0.8270***	-0.8779 ***	-0.7157 ***
Social capital (weak)			0.1878
Extraversion	0.0109	0.0036	0.0673
Neuroticism	0.1117	0.3281	0.0034
Year 1994–1997	-0.9093***	-1.2090 ***	-0.7447 **
Year 1998–2001	-0.4200	-0.5573 *	-0.4186
Nace 2	-0.0051	-0.5698	0.2807
Nace 3	0.0844	-0.1331	0.0674
Nace 7	0.1703	0.1698	0.1041
Constant	0.1859	-0.8186	-0.4240
N	441	340	342
LR chi2 (k)	(9) 35.64	(10) 51.62	(11) 16.63
Prob > LR	0.0000	0.0000	0.1192
Pseudo R2	0.0591	0.1294	0.0408

Table B.4: Estimation of the propensity score

B.3 Imposition of the common support

The common support condition ensures that any set of characteristics of assisted founders and their start-ups (which is captured by the propensity score) can be also observed for nonassisted ones. The kernel density functions (Figure B.1) illustrate the distribution of the propensity score for assisted and nonassisted observations – overall and separately for each cluster-specific analysis. The region of common support lies within the overlap (highlighted by the black boxes). The condition of common support requires discarding 3 (8, 7) observations from the analysis of business assistance overall (Cluster 1, Cluster 2).



Note: Observations inside the region of common support lie within the black box. All observations outside the box are excluded from the matching procedure.

Figure B.1: Distribution of the propensity score for the analysis of business assistance overall, Cluster 1 business assistance, and Cluster 2 business assistance

B.4 Matching quality

T-tests for equality of means in the assisted and nonassisted start-ups indicate the balancing of the variables before and after matching (Tables B.5-B.7). After matching, assisted and nonassisted start-ups differ only with respect to strong social capital in the analysis of business assistance in general (Overall take-up, Table B.5). This should not be of concern since there is no evidence that this variable impacts on our outcome variables.

Overall take-up of business assistance

	Before matching		**Initial capital** **After matching**		**Employment** **After matching**		**Credit rating** **After matching**	
	Mean of…		Mean of matched…		Mean of matched…		Mean of matched…	
	… assisted start-ups	… non-assisted start-ups (potential controls)	… assisted start-ups	… non-assisted start-ups (actual controls)	… assisted start-ups	… non-assisted start-ups (actual controls)	… assisted start-ups	… non-assisted start-ups (actual controls)
	N = 194	**N = 251**	**N = 189**	**N = 249**	**N = 186**	**N = 239**	**N = 161**	**N = 202**
Academic spin-off	**0.16**	**0.07**	0.16	0.17	0.17	0.17	0.18	0.17
Novelty	1.38	1.25	1.41	1.36	1.42	1.34	1.51	1.40
Previous self-employment	**0.28**	**0.45**	0.28	0.28	0.26	0.28	0.27	0.27
Parents self-employed	0.14	0.19	0.14	0.18	0.13	0.17	0.13	0.17
Social capital (weak)	**0.33**	**0.24**	0.34	0.27	0.34	0.28	0.35	0.28
Social capital (strong)	0.40	0.34	**0.41**	**0.32**	**0.41**	**0.31**	**0.42**	**0.31**
Team start-up	0.66	0.69	0.67	0.72	0.67	0.72	0.68	0.74
Conscientious-ness	3.62	3.67	3.60	3.67	3.61	3.67	3.58	3.65
Extraversion	3.19	3.22	3.19	3.22	3.18	3.21	3.20	3.23
Agreeableness	3.11	3.07	3.10	3.10	3.10	3.10	3.11	3.07
Openness	3.20	3.16	3.20	3.20	3.20	3.19	3.22	3.20
Neuroticism	1.38	1.37	1.40	1.36	1.40	1.36	1.40	1.37
Entr. person. profile	-21.75	-21.04	-21.78	-21.04	-21.81	-21.10	-21.73	-20.91
Year 1994–97	**0.32**	**0.47**	0.31	0.35	0.32	0.35	0.29	0.32
Year 1998–01	0.37	0.34	0.38	0.37	0.38	0.37	0.36	0.35
Year 2002–06	**0.31**	**0.20**	0.31	0.29	0.30	0.29	0.35	0.33
Nace 2	0.21	0.24	0.20	0.21	0.20	0.21	0.20	0.22
Nace 3	0.24	0.24	0.25	0.28	0.25	0.28	0.27	0.30
Nace 7	0.39	0.33	0.39	0.36	0.38	0.36	0.39	0.34
Nace x	0.16	0.19	0.16	0.14	0.16	0.15	0.14	0.14
Propensity score	**0.48**	**0.40**	0.48	0.47	0.48	0.47	0.49	0.48

Please note: The balancing of the variables is shown after kernel matching with the optimal bandwidth. Bold numbers indicate significant different means between observation from assisted start-ups and nonassisted start-ups before and after matching in a two-sided t-test (10% significance level). Because of the imposition of the common support (see Appendix B.3) and missing values for each outcome variable, the matched samples have fewer observations. Furthermore, each t-test might lack observations because of refusals for several variables.

Table B.5: Group differences between assisted and nonassisted start-ups before and after matching

Take-up of Cluster 1 business assistance								
	Before matching		**Initial capital**		**Employment**		**Credit rating**	
			After matching		**After matching**		**After matching**	
	Mean of…		Mean of matched…		Mean of matched…		Mean of matched…	
	… assisted start-ups	… non-assisted start-ups (potential controls)	… assisted start-ups	… non-assisted start-ups (actual controls)	… assisted start-ups	… non-assisted start-ups (actual controls)	… assisted start-ups	… non-assisted start-ups (actual controls)
	N = 96	**N = 251**	**N = 93**	**N = 239**	**N = 91**	**N = 229**	**N = 82**	**N = 192**
Academic spin-off	**0.27**	**0.07**	0.27	0.25	0.27	0.25	0.28	0.25
Novelty	**1.86**	**1.25**	1.90	1.88	1.92	1.86	2.01	1.97
Previous self-employment	**0.27**	**0.45**	0.28	0.31	0.26	0.30	0.29	0.31
Parents self-employed	0.15	0.19	0.15	0.16	0.13	0.15	0.16	0.14
Social capital (weak)	**0.36**	**0.24**	0.36	0.29	0.37	0.30	0.36	0.29
Social capital (strong)	0.38	0.34	0.40	0.33	0.40	0.32	0.39	0.31
Team start-up	0.68	0.69	0.68	0.75	0.68	0.75	0.68	0.78
Conscientious-ness	3.56	3.67	3.56	3.64	3.55	3.64	3.54	3.64
Extraversion	3.15	3.22	3.16	3.19	3.16	3.18	3.17	3.22
Agreeableness	3.08	3.07	3.07	3.08	3.06	3.09	3.07	3.06
Openness	3.25	3.16	3.24	3.23	3.25	3.22	3.28	3.23
Neuroticism	1.40	1.37	1.40	1.39	1.41	1.38	1.39	1.36
Entr. person. profile	-21.92	-21.04	-21.83	-21.21	-21.86	-21.25	-21.62	-20.88
Year 1994–1997	**0.25**	**0.47**	0.25	0.27	0.25	0.27	0.21	0.23
Year 1998–2001	0.40	0.34	0.40	0.40	0.41	0.40	0.40	0.40
Year 2002–2006	**0.35**	**0.20**	0.35	0.33	0.34	0.33	0.39	0.36
Nace 2	**0.13**	**0.24**	0.13	0.13	0.13	0.13	0.13	0.14
Nace 3	0.29	0.24	0.29	0.28	0.30	0.28	0.30	0.30
Nace 7	**0.44**	**0.33**	0.44	0.46	0.43	0.46	0.43	0.44
Nace x	0.15	0.19	0.14	0.13	0.14	0.13	0.13	0.12
Propensity score	**0.38**	**0.23**	0.38	0.37	0.39	0.37	0.40	0.38

Please note: The balancing of the variables is shown after kernel matching with the optimal bandwidth. Bold numbers indicate significant different means between observation from assisted start-ups and nonassisted start-ups before and after matching in a two-sided t-test (10% significance level). Because of the imposition of the common support (see Appendix B.3) and missing values for each outcome variable, the matched samples have fewer observations. Furthermore, each t-test might lack observations because of refusals for several variables.

Table B.6: Group differences between assisted and nonassisted start-ups before and after matching

Take-up of Cluster 2 business assistance								
	Before matching		**Initial capital** **After matching**		**Employment** **After matching**		**Credit rating** **After matching**	
	Mean of…		Mean of matched…		Mean of matched…		Mean of matched…	
	… assisted start-ups	… non-assisted start-ups (potential controls)	… assisted start-ups	… non-assisted start-ups (actual controls)	… assisted start-ups	… non-assisted start-ups (actual controls)	… assisted start-ups	… non-assisted start-ups (actual controls)
	N = 98	**N = 251**	**N = 97**	**N = 238**	**N = 96**	**N = 229**	**N = 80**	**N = 193**
Academic spin-off	0.06	0.07	0.06	0.07	0.06	0.07	0.08	0.07
Novelty	**0.91**	**1.25**	0.92	0.91	0.92	0.92	0.96	0.94
Previous self-employment	**0.29**	**0.45**	0.29	0.30	0.28	0.29	0.28	0.28
Parents self-employed	0.14	0.19	0.14	0.20	0.14	0.18	0.12	0.19
Social capital (weak)	0.30	0.24	0.30	0.29	0.29	0.29	0.33	0.30
Social capital (strong)	0.42	0.34	0.41	0.34	0.41	0.33	0.45	0.35
Team start-up	0.65	0.69	0.65	0.69	0.65	0.68	0.66	0.71
Conscientious-ness	3.67	3.67	3.67	3.67	3.68	3.66	3.65	3.63
Extraversion	3.23	3.22	3.23	3.24	3.22	3.23	3.26	3.24
Agreeableness	3.14	3.07	3.14	3.07	3.15	3.07	3.16	3.03
Openness	3.16	3.16	3.16	3.15	3.15	3.15	3.16	3.15
Neuroticism	1.36	1.37	1.36	1.34	1.36	1.34	1.37	1.37
Entr. person. profile	-21.59	-21.04	-21.59	-20.95	-21.64	-20.95	-21.69	-20.89
Year 1994–1997	0.39	0.47	0.38	0.38	0.39	0.38	0.38	0.36
Year 1998–2001	0.35	0.34	0.35	0.38	0.35	0.38	0.31	0.36
Year 2002–2006	0.27	0.20	0.27	0.24	0.26	0.24	0.31	0.28
Nace 2	0.29	0.24	0.29	0.28	0.29	0.27	0.30	0.30
Nace 3	0.19	0.24	0.20	0.21	0.20	0.22	0.21	0.22
Nace 7	0.35	0.33	0.34	0.32	0.33	0.33	0.35	0.31
Nace x	0.17	0.19	0.18	0.18	0.18	0.18	0.14	0.17
Propensity score	**0.32**	**0.27**	0.32	0.31	0.32	0.31	0.33	0.32

Please note: The balancing of the variables is shown after kernel matching with the optimal bandwidth. Bold numbers indicate significant different means between observation from assisted start-ups and nonassisted start-ups before and after matching in a two-sided t-test (10% significance level). Because of the imposition of the common support (see Appendix B.3) and missing values for each outcome variable, the matched samples have fewer observations. Furthermore, each t-test might lack observations because of refusals for several variables.

Table B.7: Group differences between assisted and nonassisted start-ups before and after matching

References

Abadie, A. and Imbens, G. W. (2008), Notes and Comments on the Failure of the Bootstrap for Matching Estimators, Econometrica, 76, 6, 1537-1557.

Acs, Z. J. (2008), Foundations of High Impact Entrepreneurship, Foundations and Trends in Entrepreneurship, 4, 6, 535-620.

Acs, Z. J. and Audretsch, D. B. (1990), Innovation and small firms, MIT Press, Cambridge, MA.

Acs, Z. J. and Audretsch, D. B. (1993), Small Firms and Entrepreneurship: An East-West Perspective, Cambridge University Press: Cambridge.

Acs, Z. J. and Mueller, P. (2008), Employment effects of business dynamics: Mice, Gazelles and Elephants, Small Business Economics, 30, 85-100.

Agarwal, R., Echambadi, R., Franco, A. M., Sarkar, M. B. (2004), Knowledge transfer through inheritance: spin-out generation, development and survival. Academy of Management Journal, 47, 4, 501–522.

Almus, M., Nerlinger, E. A. and Steil, F. (1999), Growth Determinants of Start-ups in Eastern Germany, A Comparison between Innovative and Non-innovative Firms, in: Oakey, R., During, W. and Mukhtar, S.-M., New Technology-Based Firms in the 1990s, Bd. VI, Amsterdam, 283-296.

Ardichvili, A., Cardozo, R. and Ray, S. (2003), A theory of entrepreneurial opportunity identification and development, Journal of Business Venturing, 18(1), 105-123.

Arrow, K. J. (1962), Economic welfare and the allocation of resources for invention, in: Nelson, R. R. (ed.), The Rate and Direction of Inventive Activity, Princeton: Princeton University Press, 609-625.

Aschhoff, B. (2008), Who Gets the Money? The Dynamics of R&D Project Subsidies in Germany, ZEW Discussion Paper No. 08-018.

Åstebro, T. and Bernhardt, I. (2003), Start-Up Financing, Owner Characteristics, and Survival, Journal of Economics and Business, 55, 303-319.

Åstebro, T. and Bernhardt, I. (2005), The Winner's Curse of Human Capital, Small Business Economics, 24, 63-78.

Audretsch, D. B. (2003), Entrepreneurship Policy and the Strategic Management of Places, in: Hart, D. M. (ed.), The Emergence of Entrepreneurship Policy: governance, start-ups, and growth in the U.S. Knowledge Economy, Cambridge, UK: Cambridge University Press, 20-38.

Audretsch, D. B. (2006), Entrepreneurship, Innovation and Economic Growth, Cheltenham: Edward Elgar Publishing.

Audretsch, D. B. and Beckmann, I. A. (2007), From small business to entrepreneurship, in: Audretsch, D. B., Grilo, I. and Thurik, A. (eds.), Handbook of Research on Entrepreneurship Policy, Cheltenham, UK; Northampton, MA, USA: Edward Elgar Publishing, 36-53.

Audretsch, D. B. and Feldman, M. P. (1996), R&D Spillovers and the Geography of Innovation and Production, American Economic Review, 86, 641-652.

Audretsch, D. B., Grilo, I. and Thurik, A. (2007), Explaining entrepreneurship and the role of policy: a framework, in: Audretsch, D. B, Grilo, I. and Thurik, A. (eds.), Handbook of

Research on Entrepreneurship Policy Cheltenham, UK; Northampton, MA, USA: Edward Elgar Publishing, 1-17.

Audretsch, D. B. and Keilbach, M. (2004), Entrepreneurship and regional growth: an evolutionary interpretation, Journal of Evolutionary Economics, 14, 605-616.

Audretsch, D. B., Keilbach, M. and Lehmann, E. (2006), Entrepreneurship and Economic Growth, New York: Oxford University Press.

Audretsch, D. B. and Thurik, A. R. (2001), What's New about the New Economy? Sources of Growth in the Managed and Entrepreneurial Economies, Industrial and Corporate Change, 10, 1, 267-315.

Audretsch, D. B. and Thurik, A. R. (2004), A Model of the Entrepreneurial Economy, International Journal of Entrepreneurship Education, 2, 2, 143-166.

Auerswald, P. E. (2007), The simple economics of technology entrepreneurship: market failure reconsidered, in: Audretsch, D. B, Grilo, I. and Thurik, A. (eds.), Handbook of Research on Entrepreneurship Policy, Cheltenham, UK; Northampton, MA, USA: Edward Elgar Publishing, 18-35.

Autio, E. (2005), GEM 2005 Report on High-Expectation Entrepreneurship, Global Entrepreneurship Monitor. Available at: http://www.gemconsortium.org/download.asp?fid=444 (accessed on 2009-12-10).

Bamford, C. E., Dean, T. J. and McDougall, P. P. (2000), An examination of the impact of initial founding conditions and decisions upon the performance of new bank start-ups, Journal of Business Venturing, 15, 3, 253-277.

Baptista, R. and Preto, M. T. (2006), Entrepreneurship and Industrial Re-structuring: What Kinds of Startups Matter Most for Job Creation? Technical University of Lisbon, IN+, Instituto Superior Técnico, Discussion Paper 06/06.

Barney, J. B., Busenitz, L. W., Fiet, J. O. and Moesel, D. D. (1996), New Venture Teams' Assessment of Learning Assistance from Venture Capital Firms, Journal of Business Venturing, 11, 257-272.

Baron, R. A. (2006), Opportunity Recognition as Pattern Recognition: How Entrepreneurs "Connect the Dots" to Identify New Business Opportunities, Academy of Management Perspectives, 104-119.

Baron, R. M. and Kenny, D. A. (1986), The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations, Journal of Personality and Social Psychology, 51, 6, 1173-1182.

Bartelsman, E., Scarpetta, S. and Schivardi, F. (2005), Comparative analysis of firm demographics and survival: evidence from micro-level sources in OECD countries, Industrial and Corporate Change, 14, 365-391.

Bassi, L. J. (1984), Estimating the Effect of Training Programs with Non-random Selection, The Review of Economics and Statistics, 66, 1, 36-43.

Baumgartner, H. J. and Caliendo, M. (2008), Turning Unemployment into Self-Employment: Effectiveness of Two Start-Up Programmes, Oxford Bulletin of Economics and Statistics, 70, 3, 347-373.

Becker, S. O. and Ichino, A. (2002), Estimation of average treatment effects based on propensity scores, The Stata Journal, 2, 4, 358-377.

Belitz, H., Berteit, H., Fleischer, F. and Stephan, A. (2001), Staatliche Förderung von Forschung und Entwicklung in der ostdeutschen Wirtschaft – Eine Bilanz, Deutsches Institut für Wirtschaftsforschung, Wochenbericht, 68, 35, 537-544.

Belli, R. F., Lee, E. H., Stafford, F. P. and Chou, C. (2004), Calendar and question-list survey methods: Association between interviewer behaviors and data quality, Journal of Official Statistics, 20, 2, 185-218.

Bhidé, A. V. (2000), The Origin and Evolution of New Businesses, New York: Oxford University Press.

Binks, M. and Ennew, C. (1996), Growing firms and the credit constraint, Small Business Economics, 8, 17-25.

Birch, D. L. (1979), The Job Generation Process, Cambridge, MA: MIT Programme on Neighborhood and Regional Change.

Blanes, J. V. and Busom, I. (2004), Who participates in R&D subsidy programs? The case of Spanish manufacturing firms, Research Policy, 33, 10, 1459-1476.

Blumberg, B. F. and Letterie, W. A. (2008), Business Starters and Credit Rationing, Small Business Economics, 30, 2, 187-200.

BMBF (2006), The High-Tech Strategy for Germany, Bundesministerium für Bildung und Forschung – Federal Ministry of Education and Research, Berlin. Available at: http://www.bmbf.de/pub/bmbf_hts_lang_eng.pdf (accessed on 2009-04-02).

Bosma, N., Acs, Z. J., Autio, E., Coduras, A. and Levie, J. (2008), Global Entrepreneurship Monitor Executive Report 2008.

Bridge, S., O'Neill, K. and Cromie, S. (2003), Understanding Enterprise, Entrepreneurship and Small Business, 2nd Edition, New York: Palgrave Macmillan.

Brüderl, J., Preisendörfer, P., and Ziegler, R. (1992), Survival Chances of Newly Founded Business Organizations, American Sociological Review, 57, 2, 227-242.

Buenstorf, G. (2007), Creation and Pursuit of Entrepreneurial Opportunities: An Evolutionary Economics Perspective, Small Business Economics, 28, 4, 323-337.

Buenstorf, G. (2009), Opportunity spin-offs and necessity spin-offs, International Journal of Entrepreneurial Venturing, 1, 1, 22-40.

Buenstorf, G. and Fornahl, D. (2009), B2C—bubble to cluster: the dot-com boom, spin-off entrepreneurship, and regional agglomeration, Journal of Evolutionary Economics, 19, 3, 349–378.

Bundesagentur für Arbeit (2009), Finanzielle Hilfen für Existenzgründer. Available at: http://www.arbeitsagentur.de/nn_26400/Navigation/zentral/Buerger/Hilfen/Existenzgruendung/Existenzgruendung-Nav.html (accessed on 2009-12-10).

Bundesministerium für Wirtschaft und Technologie (2008), GründerZeiten: Informationen zur Existenzgründung und -sicherung, Beratung, Nr. 32, Oktober 2008. Available at: http://www.existenzgruender.de/imperia/md/content/pdf/publikationen/gruenderzeiten/gz_32.pdf (accessed on 2009-12-10).

Bundesregierung (2007), Jahresbericht der Bundesregierung zum Stand der Deutschen Einheit 2007, Chancen nutzen, Zusammenhalt sichern, Bundesministerium für Verkehr, Bau und Stadtentwicklung, Berlin. Available at: http://www.bmvbs.de/Anlage/original_1013253/Jahresbericht-zur-Deutschen-Einheit-2007.pdf (accessed on 2009-12-10).

Bundesregierung (2008), Jahresbericht der Bundesregierung zum Stand der deutschen Einheit 2008, Die neuen Länder – für ein modernes und soziales Deutschland, Bundesministerium für Verkehr, Bau und Stadtentwicklung, Berlin. Available at: http://www.bmi.bund.de/cae/servlet/contentblob/816900/publicationFile/50787/2008.pdf (accessed on 2009-12-10).

Buss, T. F. (2002), Emerging High-Growth Firms and Economic Development Policy, Economic Development Quarterly, 16, 1, 17-19.

Caliendo, M. (2006), Microeconometric Evaluation of Labour Market Policies, Lecture Notes in Economics and Mathematical Systems, Berlin, Heidelberg: Springer.

Caliendo, M., Kühn, S. and Wießner, F. (2008), Die Nachhaltigkeit von geförderten Existenzgründungen aus Arbeitslosigkeit: Eine Bilanz nach fünf Jahren, Forschungsinstitut zur Zukunft der Arbeit, No. 3880.

Cantillon, R. (1755), Essai sur la Nature du Commerce en Général, Klassiker der Nationalökonomie, Düsseldorf Verlag Wirtschaft und Finanzen, repr. 1987.

Cantner, U. and Kösters, S. (2009a), Picking the Winner? Empirical Evidence on the Targeting of R&D Subsidies to Start-ups, Jena Economic Research Papers, # 2009-093.

Cantner, U. and Kösters, S. (2009b). R&D Subsidies to Start-ups – Effective Drivers of Patent Activity and Employment Growth?, Jena Economic Research Papers, # 2009-027.

Carpenter, R. E. and Petersen, B. C. (2002), Capital market imperfections, high-tech investment, and new equity financing, Economic Journal, 112, F54-F72.

Carree, M. A. and Thurik, A. R. (2003), The Impact of Entrepreneurship on Economic Growth, in: Acs, Z. J. and Audretsch, D. B. (eds.), Handbook of Entrepreneurship Research, An Interdisciplinary Survey and Introduction, Dordrecht: Kluwer Academic Publishers, 437-472.

Caspi, A., Moffitt, T. E., Thornton, A., Freedman, D., Amell, J. W., Harrington, H., Smeijers, J. and Silva, P. A. (1996), The Life History Calendar: A research and clinical assessment method for collecting retrospective event-history data, International Journal of Methods in Psychiatric Research, 6, 101-114.

Caspi, A., Roberts, B. W. and Shiner, R. L. (2005), Personality development: stability and change, Annual Review of Psychology, 56, 453-84.

Chaminade, C. and Edquist, C. (2005), From Theory to Practice: The Use of the Systems of Innovation Approach in Innovation Policy, in: Hage, J., Meeus, M. T. and Thore, J. (eds.), Innovation, Science, and Institutional Change, Oxford: Oxford University Press, 141-160.

Chrisman, J. J. (1989), Strategic, Administrative and Operating Assistance: The Value of Outside Consulting to Pre-Venture Entrepreneurs, Journal of Business Venturing, 4, 6, 401-418.

Chrisman, J. J. (1999), The Influence of Outsider-Generated Knowledge Resources on Venture Creation. Journal of Small Business Management, 37, 3, 42-58.

Chrisman, J. J. and Leslie, J. (1989), Strategic, Administrative, and Operating Problems: The Impact of Outsiders on Small Firm Performance, Entrepreneurship Theory & Practice, 13, 3, 37-51.

Chrisman, J. J. and McMullan, W. E. (2000), A Preliminary Assessment of Outsider Assistance as a Knowledge Resource: The Longer-Term Impact of New Venture Counseling. Entrepreneurship Theory and Practice, 24, 3, 37-53.

Chrisman, J. J., McMullan, W. E. and Hall, J. (2005), The influence of guided preparation on the long-term performance of new ventures. Journal of Business Venturing, 20, 769-791.

Cohen, W. M. and Klepper, S. (1992), The Tradeoff Between Firm Size and Diversity in the Pursuit of Technological Progress, Small Business Economics, 4, 1-14.

Cohen, W. M. and Levinthal, D. A. (1990), Absorptive Capacity: A New Perspective on Learning and Innovation, Administrative Science Quarterly, 35, 1, 128-152.

Colombo, M. G. and Grilli, L. (2005), Founders' Human Capital and the Growth of New Technology-Based Firms: A Competence-Based View, Research Policy, 34, 795-816.

Colombo, M. G. and Grilli, L. (2007), Funding Gaps? Access To Bank Loans By High-Tech Start-Ups, Small Business Economics, 29, 25-46.

Cooper, A. C., Folta, T. B. and Woo, C. Y. (1995), Entrepeneurial Information Search, Journal of Business Venturing, 10, 2, 107-120.

Cooper, A. C., Gimeno-Gascon, F. and Woo, C. Y. (1994), Initial Human and Financial Capital Predictors of New Venture Performance, Journal of Business Venturing, 9, 5, 371-395.

Costa, P. T. J. and McCrae, R. R. (1992), Revised NEO Personality Inventory and NEO Five Factor Inventory (NEO-FFI) professional manual, Odessa, FL: Psychological Assessment Resources.

Cowling, M. and Mitchell, P. (2003), Is the Small Firms Loan Guarantee Scheme Hazardous for Banks or Helpful to Small Business?, Small Business Economics, 21, 1, 63-71.

Cressy, R. (1996), Are Business Startups Debt-Rationed? Economic Journal, 106, 438, 1253-1270.

Cressy, R. (2002), Funding Gaps—A Symposium, The Economic Journal, 112, F1-F16.

Czarnitzki, D. (2001), Die Auswirkungen der Forschungs- und Technologiepolitik auf die Innovationsaktivitäten ostdeutscher Unternehmen, Schmollers Jahrbuch – Zeitschrift für Wirtschafts- und Sozialwissenschaften, 121, 4, 1-22.

Czarnitzki, D. and Fier, A. (2001), Do R&D Subsidies Matter? – Evidence for the German Service Sector, ZEW Discussion Paper No. 01-19.

Czarnitzki, D., Ebersberger, B. and Fier, A. (2007), The Relationship Between R&D Collaboration, Subsidies and R&D Performance: Empirical Evidence from Finland and Germany, Journal of Applied Econometrics, 22, 1347-1366.

Czarnitzki, D. and Kraft, K. (2007), Are Credit Ratings Valuable Information?, Applied Financial Economics, 17, 13, 1061-1070.

Czarnitzki, D. and Licht, G. (2006), Additionality of public R&D grants in a transition economy – The case of Eastern Germany, Economics of Transition, 14, 1, 101-131.

Czarnitzki, D., Licht, G. and Spielkamp, A. (2003), Die Rolle der Innovationsförderung im Aufholprozess in Ostdeutschland, Hintergrundmaterialien zum Forschungsauftrag Nr. 13/01: Fortschrittsberichte über die wirtschaftliche Entwicklung in Ostdeutschland, Zentrum für Europäische Wirtschaftsforschung. Available at: http://www.iwh-halle.de/projects/fsb2003/kap6-3_lang_final.pdf (accessed on 2009-12-10).

David, P. A., Hall, B. H. and Toole, A. A. (2000), Is public R&D a complement or substitute for private R&D? A review of the econometric evidence, Research Policy, 29, 497-529.

Davidsson, P. (2002), What Entrepreneurship Research can do for Business and Policy Practice. International Journal of Entrepreneurship Education, 1, 1, 5-24.

Davidsson, P. and Honig, B. (2003), The role of social and human capital among nascent entrepreneurs. Journal of Business Venturing, 18, 3, 301-331.

De Meza, D. (2002), Overlending? Economic Journal, 112, 477, F17–F31.

De Meza, D. and Webb, D. C. (1987), Too Much Investment: A Problem of Asymmetric Information, The Quarterly Journal of Economics, 102, 2, 281-292.

Deutscher Bundestag (2005), Förderung von Forschung und Entwicklung in Ostdeutschland, Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Michael Kretschmer, Katherina Reiche, Thomas Rachel, weiterer Abgeordneter und der Fraktion der CDU/CSU, Drucksache 15/5808. Available at: http://dip21.bundestag.de/dip21/btd/15/058/1505808.pdf (accessed on 2009-12-10).

DiNardo, J. and Tobias, J. L. (2001), Nonparametric Density and Regression Estimation, Journal of Economic Perspectives, 15(4), 11-28.

DIW, IAB, IfW, IWH, ZEW (2003), Zweiter Fortschrittsbericht wirtschaftswissenschaftlicher Institute über die wirtschaftliche Entwicklung in Ostdeutschland, Wochenbericht des DIW Berlin Nr. 47, 737-760.

Edquist, C. (2001), Innovation Policy in the Systems of Innovation Approach: Some Basic Principles, in: Fischer, M. M. and Fröhlich, J. (eds.), Knowledge, Complexity and Innovation Systems, Advances in Spatial Science, Berlin, Heidelberg: Springer Verlag, 46-57.

Eickelpasch, E. and Fritsch, M. (2005), Contest for cooperation – a new approach in German innovation policy, Research Policy, 34, 8, 1269-82.

Elder, G. H. J. and Caspi, A. (1990), Studying lives in a changing society: Sociological and personal explorations, in: Zucker, R. A., Rabin, A. I., Aronoff, J. and Frank, S. J. (eds.), Personality structure in the life course, New York: Springer, 276-322.

ESF (2009), European Social Fund – Improving the adaptability and competitiveness of workers and enterprises, Germany, Thüringen, ESF priority area, Supporting self employment and new businesses. Available at: http://ec.europa.eu/employment_social/emplweb/esf_projects_117/project.cfm?id=968&project_lang=en (accessed on 2009-12-10).

European Commission (2001), Creating Top-Class Business Support Services. Commission of the European Communities, Commission Staff Working Paper, SEC (2001) 1937.

Evans, D. and Jovanovic, B. (1989), Estimates of a model of entrepreneurial choice under liquidity constraints, Journal of Political Economy, 97, 808-827.

Fier, A. and Heneric, O. (2005), Public R&D policy: The right turns of the wrong screw? The case of the German Biotechnology Industry, ZEW Discussion Paper No. 05-60.

Fouad, N. A. (2006), Work and Vocational Psychology: Theory, Research, and Applications, Annual Review of Psychology, 58, 543-564.

Fritsch, M. (2004), Entrepreneurship, entry and performance of new business compared in two growth regimes: East and West Germany, Journal of Evolutionary Economics, 14, 5, 525–542.

Fritsch, M. (2008), How Does New Business Formation Affect Regional Development? Introduction to the Special Issue, Small Business Economics, 30, 1, 1-14.

Fritsch, M., Erbe, A., Noseleit, F. and Schröter, A. (2009), Innovationspotenziale in Thüringen, Stand und Perspektiven, Stiftung für Technologie, Innovation und Forschung Thüringen (STIFT), Erfurt.

Fritsch, M. and Mueller, P. (2004), Effects of New Business Formation on Regional Development over Time, Regional Studies, 38, 961- 975.

Fritsch, M. and Mueller, P. (2007), The Persistence of Regional New Business Formation-Activity over Time – Assessing the Potential of Policy Promotion Programs, Journal of Evolutionary Economics, 17, 299-315.

Fritsch, M. and Mueller, P. (2008), The Effect of New Business Formation on Regional Development over Time: The Case of Germany, Small Business Economics, 30, 1, 15-29.

Fritsch, M. and Schroeter, A. (2009), Are More Start-Ups Really Better? Quantity and Quality of New Businesses and Their Effect on Regional Development, Jena Economic Research Papers, # 2009-070.

Geroski, P. A. (1995), What do we know about entry, International Journal of Industrial Organization, 13, 4, 421- 440.

Glaeser, E., Kallal, H., Sheinkman, J. and Schleifer, A. (1992), Growth in cities, Journal of Political Economy, 100, 1126-1152.

Goldfarb, B. and Henrekson, M. (2003), Bottom-up versus top-down policies towards the commercialization of university intellectual property, Research Policy, 32, 639–658.

González, X., Jaumandreu, J. and Pazó, C. (2005), Barriers to innovation and subsidy effectiveness, RAND Journal of Economics, 36, 930-950.

Goolsbee, A. (1998), Does Government R&D Policy Mainly Benefit Scientists and Engineers?, American Economic Review, 88, 2, 298-302.

Granovetter, M. (1973), The strength of weak ties, American Journal of Sociology, 78, 6, 1360-1380.

Griliches, Z. (1990), Patent statistics as economic indicators, Journal of Economic Literature, 92, 630-53.

Griliches, Z. (1992), The search for R&D spillovers, Scandinavian Journal of Economics, 94, Supplement, 29-47.

Grupp, H. and Legler, H. (2000), Hochtechnologie 2000: Neudefinition der Hochtechnologie für die Berichterstattung zur technologischen Leistungsfähigkeit Deutschlands, Karlsruhe/Hannover: Fraunhofer-Institut für Systemtechnik und Innovationsforschung (ISI) und Niedersächsisches Institut für Wirtschaftsforschung (NIW).

Gu, Q., Karoly, L. A. and Zissimopoulos, J. (2008), Small Business Assistance Programs in the United States, Working Paper Kauffman-RAND Institute for Entrepreneurship Public Policy.

Guiso, L. (1998), High-tech firms and credit rationing, Journal of Economic Behavior & Organization, 35, 39-59.

Hall, B. H. (2002), The Financing of Research and Development, Oxford Review of Economic Policy, 18, 1, 35-51.

Hall, B. H., Griliches, Z. and Hausman, J. A. (1986), Patents and R and D: Is there a Lag?, International Economic Review, 27, 2, 265-285.

Hart, D. M. (2003a), Entrepreneurship Policy: What It Is and Where It Came From, in: Hart, D. M. (ed.), The Emergence of Entrepreneurship Policy, Cambridge, UK: Cambridge University Press, 3-19.

Hart, D. M. (2003b), Knowledge, Power, and Entrepreneurs: A First Pass at the Politics of Entrepreneurship Policy, in: Hart, D. M. (ed.), The Emergence of Entrepreneurship Policy – Governance, Start-ups, and Growth in the U.S. Knowledge Economy, Cambridge, UK: Cambridge University Press, 227-239.

Hébert, R. F. and Link, A. N. (1988), The Entrepreneur, Mainstream Views and Radical Critiques, Praeger, New York.

Heckhausen, J. and Schulz, R. (1995), A life-span theory of control, Psychological Review, 102, 284-304.

Heckhausen, J., Wrosch, C. and Fleeson, W. (2001), Developmental regulation before and after a developmental deadline: The sample case of 'biological clock' for childbearing, Psychology and Aging, 16, 3, 400-413.

Heckman, J., Ichimura, H., Smith, J. and Todd, P. (1998), Matching as an Econometric Evaluation Estimator, Review of Economic Studies, 65, 2, 261-294.

Heckman, J., Ichimura, H. and Todd, P. (1997), Matching As An Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme, The Review of Economic Studies, 64, 4, 605-654.

Heckman, J. J., Lalonde, R. J. and Smith, J. A. (1999), The Economics and Econometrics of Active Labor Market Programs, in: Ashenfelter, A. and Card, D. (eds.), Handbook of Labor Economics, 3, Amsterdam: Elsevier, 1865-2097.

Heimpold, G. (1998), Zulagen – Zuschüsse – Darlehen? Zur Qualität regionalpolitischer Instrumente, Wirtschaft im Wandel 11/1998, 4-8.

Henrekson, M. and Johansson, D. (2008), Gazelles as Job Creators – A Survey and Interpretation of the Evidence, IFN Working Paper No. 733, 2008.

Himmelberg, C. P. and Petersen, B. C. (1994), R&D and Internal Finance: A Panel Study of Small Firms in High-Tech Industries, The Review of Economics and Statistics, 76, 1, 38-51.

Hjalmarsson, D. and Johansson, A. W. (2003), Public advisory services - theory and practice, Entrepreneurship & Regional Development, 15, 1, 83-98.

Holland, J. L. (1997), Making vocational choices. A theory of vocational personalities and work environments, Odessa, FL.: Psychological Assessment Resources.

Holtz-Eakin, D. (2000), Public Policy Toward Entrepreneurship, Small Business Economics, 15, 283-291.

Holtz-Eakin, D., Joulfaian, D. and Rosen, H. S. (1994), Entrepreneurial decisions and liquidity constraints, RAND Journal of Economics, 25, 2, 334-347.

Hsu, F.-M., Horng, D.-J., Hsueh, C.-C. (2009), The effect of government-sponsored R&D programmes on additionality in recipient firms in Taiwan, Technovation, 29, 3, 204–217.

Hujer, R. and Caliendo, M. (2003), Lohnsubventionen in Deutschland - Wie sieht eine optimale Evaluierungsstrategie aus?, Quarterly Journal of Economic Research, 72, 1, 109-123.

IWH (2008), Evaluierung der FuE-Projektförderung des Sächsischen Staatsministeriums für Wirtschaft und Arbeit – Endbericht, Sonderheft 3/2008, Institut für Wirtschaftsforschung Halle.

Jack, S. L. and Anderson, A. R. (2002), The effects of embeddedness on the entrepreneurial process, Journal of Business Venturing, 17, 467–487.

Jacobs, J. (1969), The Economy of Cities, New York: Vintage Books.

Jaffe, A. B. (1996), Economic Analysis of Research Spillovers: Implications for the Advanced Technology Program, Washington, D.C., U.S. Department of Commerce, National Institute of Standards and Technology, Advanced Technology Program.

Jaffe, A. B., Trajtenberg, M. and Henderson, R. (1993), Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations, Quarterly Journal of Economics, 63, 577-598.

Jaffee, D. and Stiglitz, J. (1990), Credit Rationing, in: Friedman, B. M. and Hahn, F. H. (eds.), Handbook of Monetary Economics, Volume II, Elsevier Science Publishers B. V., 837-888.

Jones, P. R. and Cullis, J. G. (1993), Public choice and public policy: The vulnerability of economic advice to the interpretation of politicians, Public Choice, 75, 63-77.

Judge, T. A., Higgins, C. A., Thoresen, C. J. and Barrick, M. R. (1999), The Big Five personality traits, mental ability, and career success across the life span, Personnel Psychology, 52, 3, 621-652.

Kamm, J. B., Shuman, J. C., Seeger, J. A. and Nurick, A. J. (1990), Entrepreneurial Teams in New Venture Creation: A Research Agenda, Entrepreneurship Theory and Practice, 14, 4, 7-17.

Karlan, D. S. and Valdivia, M. (2006), Teaching Entrepreneurship: Impact of Business Training on Microfinance Clients and Institutions, Center Discussion Paper No. 941, Yale University, Center Discussion Papers.

Klepper, S. and Sleeper, S. D. (2005), Entry by Spinoffs, Management Science, 51, 8, 1291-1306.

Klette, T. J., Møen, J. and Griliches, Z. (2000), Do subsidies to commercial R&D reduce market failures? Microeconometric evaluation studies, Research Policy, 29, 471-495.

Koellinger, P. D. and Thurik, A. R. (2009), Entrepreneurship and the Business Cycle, Tinbergen Institute Discussion Paper, TI 2009-032/3.

Kösters, S. (2009), Subsidizing Start-ups: Policy Targeting and Policy Effectiveness, Jena Economic Research Papers, # 2009-083.

Koga, T. (2005), R&D Subsidy and Self-Financed R&D: The Case of Japanese High-Technology Start-ups, Small Business Economics, 24, 53-62.

Koschatzky, K. and Lo, V. (2005), Innovationspolitik in den neuen Ländern – Bestands-aufnahme und Gestaltungsmöglichkeiten, ISI-Schriftenreihe Innovationspotenziale, Stuttgart: Fraunhofer IRB Verlag.

Kulicke, M. (2004), Bewertung der EXIST-Initiativen durch die von ihnen betreuten Gründungen, Umfrage im Rahmen von EXIST „Existenzgründungen aus Hochschulen", Arbeitspapier der wissenschaftlichen Begleitung von EXIST, Fraunhofer-Institut für Systemtechnik und Innovationsforschung, Karlsruhe.

Kulicke, M. and Schleinkofer, M. (2008), Wirkungen von EXIST-SEED aus Sicht von Geförderten – Ergebnisse einer Befragung im Rahmen der wissenschaftlichen Begleitung von EXIST – Existenzgründungen aus der Wissenschaft im Auftrag des Bundesministeriums für Wirtschaft und Technologie (BMWi), Fraunhofer Institut für System- und Innovationsforschung. Available at: http://www.exist.de/imperia/md/content/exist-news/nachrichten/exist-seed-befragung-kurz.pdf (accessed on 2009-12-10).

Kulicke, M., Stahlecker, T., Lo, V. and Wolf, B. (2006), EXIST - Existenzgründungen aus Hochschulen, Bericht der wissenschaftlichen Begleitung zum Förderzeitraum 1998 bis 2005, ISI-Schriftenreihe Innovationspotenziale, Stuttgart: Fraunhofer IRB Verl.

Lach, S. (2002), Do R&D Subsidies Stimulate or Displace Private R&D? Evidence from Israel, The Journal of Industrial Economics, 50, 4, 369-390.

Lattimore, R., Martin, B., Madge A., and Mills, J. (1998), Design Principles for Small Business Programs and Regulations, Productivity Commission Staff Research Paper, AusInfo, Canberra, August.

Lazarus, R. S. and Folkman, S. (1984), Stress, appraisal, and coping, New York: Springer.

Lechler, T. (2001), Social Interaction: A Determinant of Entrepreneurial Team Venture Success, Small Business Economics, 16, 4, 263-278.

Legler, H., Gehrke, B., Schasse, U., Rammer, C., and Schmoch, U. (2004), Innovationsindikatoren zur technologischen Leistungsfähigkeit der östlichen Bundesländer, Studien zum deutschen Innovationssystem, Nr. 20-2004. Available at: http://www.bmbf.de/pub/studie_innovationsindikatoren_oestliche_bundeslaende_tlf_nr20-20004.pdf (accessed on 2009-12-10).

Lerner, J. (1999), The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program, Journal of Business, 72, 3, 285-318.

Lerner, J. (2002), When Bureaucrats Meet Entrepreneurs: The Design of Effective 'Public Venture Capital' Programmes, The Economic Journal, 112, F73-F84.

Leuven, E. and Sianesi, B. (2003), PSMATCH2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing, Software.

Levenson, A. R. and Willard, K. L. (2002), Do Firms Get the Financing They Want? Measuring Credit Rationing Experienced by Small Businesses in the U.S., Small Business Economics, 14, 83-94.

Lindh, T. and Ohlsson, H. (1996), Self-employment and Windfall Gains: Evidence From the Swedish Lottery, The Economic Journal, 106, 1515-1526.

Lundström, A. and Stevenson, L. A. (2005), Entrepreneurship Policy: Theory and Practice. International Studies in Entrepreneurship, New York: Springer.

Lundvall, B.-Å., Johnson, B., Andersen, E. S. and Dalum, B. (2002), National systems of production, innovation and competence building, Research Policy, 31, 213-231.

Luukkonen, T. (2000), Additionality of EU framework programmes, Research Policy, 29, 6, 711-724.

Magnusson, D. (1998), The logic and implications of a person-oriented approach, in: Cairns, R. B., Bergman, L. R. and Kagan J. (eds.), Methods and models for studying the individual, Thousand Oaks, CA: Sage, 33-64.

Markman, G. D. and Baron, R. A. (2003), Person-entrepreneurship fit: why some people are more successful as entrepreneurs than others, Human Resource Management Review, 13, 281-301.

Marshall, A. (1890), Principles of Economics, London: MacMillan, 8th edition, 1961.

McMullan, E., Chrisman, J. J. and Vesper, K. (2001), Some Problems in Using Subjective Measures of Effectiveness to Evaluate Entrepreneurial Assistance Programs, Entrepreneurship: Theory & Practice, 26, 1, 37-54.

Michalopoulos, C., Bloom, H. S. and Hill, C. J. (2004), Can propensity-score methods match the findings from a random assignment evaluation of mandatory welfare-to work programs?, Review of Economics and Statistics, 86, 1, 156-179.

Milligan, G. W. and Cooper, M. C. (1987), Methodology Review: Clustering Methods. Applied Psychological Measurement, 11, 4, 329-354.

Minniti, M. (2005), Entrepreneurship and network externalities, Journal of Economic Behavior & Organization, 57, 1-27.

Mole, K., Hart, M., Roper, S. and Saal, D. (2008), Differential gains from Business Link support and advice: a treatment effects approach, Environment and Planning C: Government and Policy, 26, 2, 315-334.

Niskanen, W. A. (1971), Bureaucracy and Representative Government, Chicago: Aldine, Atherton.

Nordhaus, W. D. (1975), The Political Business Cycle, Review of Economic Studies, 42, 2, 169-190.

OECD (2003), Entrepreneurship and Local Economic Development – Programme and Policy Recommendations, Organisation for Economic Co-operation and Development, Paris.

Ostendorf, E. (1990), Sprache und Persönlichkeitsstruktur: Zur Validität des Fünf-Faktoren-Modells der Persönlichkeit, Regensburg, Germany: S. Roeder Verlag.

Pages, E. R., Freedman, D. and Bargen, P. V. (2003), Entrepreneurship as a State and Local Economic Development Strategy, in: Hart, D. M. (ed.), The Emergence of Entrepreneurship Policy, Cambridge, UK: Cambridge University Press, 2003, 240-259.

Parker, S. C. (2002), Do Banks Ration Credit to New Enterprises? And Should Government Intervene?, Scottish Journal of Political Economy, 49, 162-195.

Parker, S. C. (2004), The Economics of Self-Employment and Entrepreneurship, Cambridge, UK: Cambridge University Press.

Parker, S. C. (2007), Policymakers beware!, in: Audretsch, D. B., Grilo, I. and Thurik, A. R. (eds.), Handbook of research on entrepreneurship policy, Max Planck Institute of Economics, Cheltenham: Edward Elgar Publishing Ltd., 54-63.

Parker, S. C. and Belghitar, Y. (2006), What Happens to Nascent Entrepreneurs? An Econometric Analysis of the PSED, Small Business Economics, 27, 1, 81-101.

Parker, S. C. and van Praag, C. M. (2006), Schooling, Capital Constraints, and Entrepreneurial Performance: The Endogenous Triangle, Journal of Business & Economic Statistics, 24, 4, 416-431.

Pinquart, M. and Silbereisen, R. K. (2004), Human Development in Times of Social Change: Theoretical Considerations and Research Needs, International Journal of Behavioral Development, 28, 289-298.

Polanyi, M. (1966), The Tacit Dimension, Garden City, NY: Doubleday.

Porter, M. (1990), The Comparative Advantage of Nations, New York: Free Press.

Rauch, A. and Frese, M. (2007), Let's put the person back into entrepreneurship research: A meta-analysis on the relationship between business owners' personality traits, business creation, and success, European Journal of Work and Organizational Psychology, 16, 4, 353-385.

Reynolds, P. D. (2007), New Firm Creation in the United States – A PSED I Overview, Foundations and Trends in Entrepreneurship, 3, 1, 1-150.

Roberts, E. B. (1991), Entrepreneurs in High Technology – Lessons from MIT and beyond, New York, Oxford: Oxford University Press.

Rosenbaum, P. and Rubin, D. (1983), The central role of the propensity score in observational studies for causal effects, Biometrika, 70, 1, 41-55.

Roy, A. (1951), Some thoughts on the distribution of earnings, Oxford Economic Papers, 3, 135-145.

Rubin, D. B. (1974), Estimating causal effects to treatments in randomised and nonrandomised studies, Journal of Educational Psychology, 66, 688-701.

Rubin, D. B. (1991), Practical Implications of Modes of Statistical Inference for Causal Effects and the Critical Role of the Assignment Mechanism, Biometrics, 47, 1213-1234.

Rubin, D. B. and Thomas, N. (1996), Matching using estimated propensity scores: relating theory to practice, Biometrics, 52, 249–264.

Rutter, M., Maughan, B., Pickles, A. and Simonoff, E. (1998), Retrospective recall recalled, in: Cairns, R. B., Bergman, L. R., and Kagan, J. (eds.), Methods and models for studying the individual, Thousands Oaks, CA: Sage, 219-243.

Santarelli, E. and Vivarelli, M. (2007), Entrepreneurship and the Process of Firms' Entry, Survival and Growth, Industrial and Corporate Change, 16, 3, 455-488.

Say, J.-B. (1803), A treatise on political economy or the production, distribution & consumption of wealth, Reprints of the economic classics, New York: Kelley, 1. American ed., reprod. of 1880 printing, 1964.

Scherer, F. M. (1984), Using linked patent and R&D data to measure interindustry technology flows, in: Griliches, Z. (ed.), R&D, Patents, and Productivity, University of Chicago Press and NBER, Chicago, 417-464.

Schindehutte, M., Morris, M. and Allen, J. (2006), Beyond achievement: Entrepreneurship as extreme experience, Small Business Economics, 27, 349-368.

Schmitt-Rodermund, E. (2004), Pathways to successful entrepreneurship: Parenting, personality, entrepreneurial competence, and interests, Journal of Vocational Behavior, 65, 498-518.

Schmitt-Rodermund, E. (2007), The long way to entrepreneurship: Personality, parenting, early interests, and competencies as precursors for entrepreneurial activity among the 'Termites', in: Silbereisen, R. K. and Lerner, R. M. (eds.), Approaches to Positive Youth Development, London: Sage, 205-224.

Schmitt-Rodermund, E. and Vondracek, F. W. (2002), Occupational Dreams, Choices and Aspirations: Adolescents' Entrepreneurial Prospects and Orientations, Journal of Adolescence, 25, 65-78.

Schroeter, A. (2009), New Rationales for Innovation Policy? A Comparison of the Systems of Innovation Policy Approach and the Neoclassical Perspective, Jena Economic Research Papers, # 2009-033.

Schumpeter, J. A. (1911), Die Theorie wirtschaftlicher Entwicklung, Berlin: Duncker & Humblot; English edition: The Theory of Economic Development (1934), Cambridge, MA: Cambridge University Press.

Shane, S. A. (2004), Academic Entrepreneurship: University Spinoffs And Wealth Creation, New Horizons in Entrepreneurship Series, Cheltenham: Edward Elgar.

Shane, S. A. (2009), Why encouraging more people to become entrepreneurs is bad public policy, Small Business Economics, 33, 141-149.

Shane, S. and Cable, D. (2002), Network Ties, Reputation, and the Financing of New Ventures. Management Science, 48, 3, 364-381.

Shaver, J. M. and Flyer, F. (2000), Agglomeration economies, firm heterogeneity, and foreign direct investment in the United States, Strategic Management Journal, 21, 12, 1175-1193.

Sianesi, B. (2004), An Evaluation of the Active Labour Market Programmes in Sweden, The Review of Economics and Statistics, 86, 1, 133-155.

Silverman, B. W. (1986), Density Estimation for Statistics and Data Analysis, Monographs on Statistics and Applied Probability, 26, London: Chapman & Hall, repr. 1993.

Smith, H. (1997), Matching with Multiple Controls to Estimate Treatment Effects in Observational Studies, Sociological Methodology, 27, 325-353.

Smith, J. (2000), A Critical Survey of Empirical Methods for Evaluating Active Labor Market Policies, Schweizerische Zeitschrift für Volkswirtschaft und Statistik, 2000, 136, 3, 247-268.

Smith, J. A. and Todd, P. E. (2005), Does matching overcome LaLonde's critique of nonexperimental estimators?, Journal of Econometrics, 125, 305-353.

Stam, E., Suddle, K., Hessels, S. J. A. and van Stel, A. (2009), High Growth Entrepreneurs, Public Policies and Economic Growth, in: Leitão, J. and Baptista, R. (eds.), Public Policies for Fostering Entrepreneurship – A European Perspective, International Studies in Entrepreneurship, 22, 1, New York: Springer, 91-110.

StataCorp. (2003), Stata Cluster Analysis – Reference Manual Release 8, College Station, TX: Stata Press.

Stephan, P. E. (1996), The Economics of Science, Journal of Economic Literature, 34, 1199-1235.

Sternberg, R. (1996), Technology Policies and the Growth of Regions: Evidence from Four Countries, Small Business Economics, 8, 75-86.

Stiglitz, J. E. and Wallsten, S. J. (2000), Public-Private Technology Partnerships – Promises and Pitfalls, in: Vaillancourt Rosenau, P. (ed.), Public-private policy partnerships, Massachusetts Institute of Technology, 37-58.

Stiglitz, J. E. and Weiss, A. (1981), Credit Rationing in Markets with Imperfect Information, American Economic Review, 71, 3, 394-410.

Stinchcombe, A. L. (1965), Social Structure and Organizations, Rand McNally & Company, Chicago, 142 - 193.

Storey, D. J. (1993), New Firm Growth and Bank Financing, Small Business Economics, 6, 139-150.

Storey, D. J. (2000), Six Steps to Heaven: Evaluating the Impact of Public Policies to Support Small Business in Developed Economies, in: Sexton, D. L. and Landström, H. (eds.), The Blackwell Handbook of Entrepreneurship, Oxford: Blackwell Publishers Ltd., 176-193.

Storey, D. J. (2003), Entrepreneurship, Small and Medium Sized Enterprises and Public Policies, in: Acs, Z. J. and Audretsch, D. B. (eds.), Handbook of Entrepreneurship Research. Boston, MA: Kluwer Academic Publishers, 473-511.

Storey, D. J. (2004), Exploring the link, among small firms, between management training and firm performance: a comparison between the UK and other OECD countries, International Journal of Human Resource Management, 15, 1, 112-130.

Stubner, S., Wulf, T. and Hungenberg, H. (2007), Management Support and the Performance of Entrepreneurial Start-ups – An Empirical Analysis of Newly Founded Companies in Germany, Schmalenbach Business Review, 59, 2, 138-159.

Sutton, J. (1997), Gibrat's legacy, Journal of Economic Literature, 35, 1, 40-59.

Taylor, M. P. (2001), Self-Employment and Windfall Gains in Britain: Evidence from Panel Data, Economica, 68, 271, 539-565.

Thurik, A. R., Carree, M. A., van Stel, A. and Audretsch, D. B. (2008), Does self-employment reduce unemployment? Journal of Business Venturing, 23, 673-686.

Thüringer Aufbaubank (2008), Geschäftsbericht 2007, Erfurt. Available at: http://www.aufbaubank.de/getfile.php?1114.pdf (accessed on 2009-12-10).

TMWA (2008a), Richtlinie zur einzelbetrieblichen Technologieförderung, Genehmigung der Europäischen Kommission Nr. N 618/2007, Az.: 3534/6-2-52, Thüringer Ministerium für Wirtschaft, Technologie und Arbeit, Erfurt. Available at: http://www.thueringen.de/de/tmwat/technologie/foerderung/richtlinien/einzel/ (accessed on 2009-12-10).

TMWA (2008b), Richtlinie zur Förderung von innovativen, technologieorientierten Verbundprojekten, Netzwerken und Clustern (Verbundförderung), Thüringer Ministerium für Wirtschaft, Technologie und Arbeit, Erfurt. Available at: http://www.thueringen.de/imperia/md/content/tmwta/techologie/richtlinien/rl_verbundf__rderung_endfassung.pdf (accessed on 2009-12-10).

TMWAI (2003), Jahreswirtschafts- und Mittelstandsbericht, Die Thüringer Wirtschaft im Jahre 2002, Thüringer Ministerium für Wirtschaft, Arbeit und Infrastruktur. Available at: http://www.thueringen.de/imperia/md/content/tmwta/publikationen/wirtschaft/jawibe2003.pdf (accessed on 2009-12-10).

TMWTA (2007), Wirtschaftsbericht für den Freistaat Thüringen 2007, Thüringer Ministerium für Wirtschaft, Technologie und Arbeit, Erfurt. Available at: http://www.thueringen.de/imperia/md/content/tmwta/publikationen/wirtschaft/wibe2007.pdf (accessed on 2009-12-10).

TMWTA (2009), Richtlinie über die Gewährung von Zuschüssen aus Mitteln des Europäischen Sozialfonds und/ oder des Freistaats Thüringen zur Förderung betriebswirtschaftlicher und technischer Beratungen von kleinen und mittleren Unternehmen und Existenzgründern (Beratungsrichtlinie), Thüringer Ministerium für Wirtschaft, Technologie und Arbeit. Available at: http://www.thueringen.de/imperia/md/content/tmwta/handel/beratungsrichtlinie__stand_8_04_2009_mit_befristung_.pdf (accessed on 2009-12-10).

Ucbasaran, D., Westhead, P. and Wright, M. (2009), The extent and nature of opportunity identification by experienced entrepreneurs, Journal of Business Venturing, 24, 99-115.

Van Praag, C. M. (1999), Some Classic Views on Entrepreneurship, De Economist, 147, 3, 311-335.

Van Praag, M., De Wit, G. and Bosma, N. (2005), Initial Capital Constraints Hinder Entrepreneurial Venture Performance, Journal of Private Equity, 9, 1, 36-44.

Van Stel, A., Carree, M. and Thurik, R. (2005), The Effect of Entrepreneurial Activity on National Economic Growth, Small Business Economics, 24, 311-321.

Van Stel, A. and Suddle, K. (2007), The impact of new firm formation on regional development in the Netherlands, Small Business Economics, 30, 31–47.

Von Hippel, E. (1994), Sticky Information and the Locus of Problem Solving: Implications for Innovation, Management Science, 40, 4, 429-439.

Wallsten, S. J. (2000), The effects of government-industry R&D programs on private R&D: the case of the Small Business Innovation Research program, RAND Journal of Economics, 31, 1, 82-100.

Wennekers, S. and Thurik, R. (1999), Linking Entrepreneurship and Economic Growth, Small Business Economics, 13, 27-55.

Wennekers, S., van Stel, A., Thurik, R. and Reynolds, P. (2005), Nascent entrepreneurship and the level of economic development, Small Business Economics, 24, 3, 293-309.

Wiklund, J. and Shepherd, D. (2003), Aspiring for, and Achieving Growth: The Moderating role of Resources and Opportunities, Journal of Management Studies, 40, 8, 1919-1941.

Wolff, G. B. and Reinthaler, V. (2008), The effectiveness of subsidies revisited: Accounting for wage and employment effects in business R&D, Research Policy, 37, 1403-1412.

Wong, P. K., Ho, Y. P. and Autio, E. (2005), Entrepreneurship, Innovation and Economic Growth: Evidence from GEM data, Small Business Economics, 24, 335-350.

Wren, C. and Storey, D. J. (2002), Evaluating the effect of soft business support upon small firm performance, Oxford Economic Papers, 54, 334-365.

Zhao, H. and Seibert, S. E. (2006), The Big Five personality dimensions and entrepreneurial status: A meta-analytic review, Journal of Applied Psychology, 91, 259-271.

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Jena, den 15. Dezember 2009

Sarah Kösters